

Appendix 8

Noise

Kodiak Airport Environmental Impact Statement

DRAFT Appendix

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Prepared for:

Federal Aviation Administration
Barnard Dunkelberg & Company Team

Prepared by:

Mestre Greve Associates
27812 El Lazo Road
Laguna Niguel, California 92677

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1.0 OUTLINE OF NOISE ANALYSIS

This report contains five (5) major sections, including this introduction. Section 2 presents background information on sound, how sound is described as noise, and the known effects that noise has on people. Section 3 describes the methodology used for this study to quantify aircraft noise exposure. Section 4 describes the baseline or existing noise in the environs of Kodiak Airport. Section 5 describes potential aircraft noise effects in the future with or without proposed Runway Safety Area improvements.

2.0 BACKGROUND INFORMATION

2.1 INTRODUCTION

This section presents background information on the characteristics of noise as it relates to the aviation alternatives and summarizes the methodologies used to study noise in an aviation environment. This section gives the reader an understanding of the metrics and methodologies used to assess noise impacts and is divided as follows:

- *Characteristics of sound that are important for technically describing sound;*
- *Factors influencing subjective human response to sound;*
- *Sound rating scales used in this study;*
- *Effects of noise on humans; and*
- *Aircraft noise regulatory context.*

2.2 CHARACTERISTICS OF SOUND

Sound Level and Frequency. Sound can be technically described in terms of the sound pressure (amplitude) and frequency (similar to pitch). Sound pressure is a direct measure of the magnitude of a sound without consideration for other factors that may influence its perception.

The range of sound pressures that occur in the environment is so large that it is convenient to express these pressures as sound pressure levels on a logarithmic scale that compresses the wide range of sound pressures to a more usable range of numbers. The standard unit of measurement of sound is the Decibel (dB), which describes the pressure of a sound relative to a reference pressure.

The frequency (pitch) of a sound is expressed as Hertz (Hz) or cycles per second. The normal audible frequency for young adults is 20 Hz to 20,000 Hz. Community noise, including aircraft and motor vehicles, typically ranges between 50 Hz and 5,000 Hz. The human ear is not equally sensitive to all frequencies, with some frequencies judged to be louder for a given signal than others. As a result of this, various methods of frequency weighting have been developed. The most common weighting is the A-weighted noise curve (dBA). The A-weighted decibel scale (dBA) performs this compensation by discriminating against frequencies in a manner approximating the sensitivity of the human ear. In the A-weighted decibel, everyday sounds normally range from 30 dBA (very quiet) to 100 dBA (very loud). Most community noise analyses, such as the evaluation of aircraft noise exposure, are based upon the A-weighted decibel scale (dBA). Examples of various sound environments, expressed in dBA, are presented in Figure 2-1.

Propagation of Noise. Outdoor sound levels decrease as the distance from the source to the receiver increases. This decrease in sound level is a result of wave divergence, atmospheric absorption, and ground attenuation. Sound radiating from a source in an undisturbed manner travels in spherical waves. As the sound wave travels away from the source, the sound energy is dispersed over a greater area, decreasing the sound power of the wave. Spherical spreading of the sound wave reduces the noise level at a rate of 6 dB per doubling of the distance.

Atmospheric absorption also influences the sound levels received by the observer. The greater the distance traveled, the greater the influence of the atmosphere and the resultant fluctuations. Atmospheric absorption becomes important at distances of greater than 1,000 feet. The degree of absorption varies depending on the frequency of the sound, as well as the humidity and temperature of the air. For example, atmospheric absorption is lowest (i.e., sound carries farther) at high humidity and high temperatures. Absorption effects in the atmosphere vary with frequency. Higher frequencies are more readily absorbed than lower frequencies. Over large distances, lower frequencies become the dominant sound as the higher frequencies are attenuated. Turbulence and gradients of wind, temperature, and humidity also play a significant role in determining the degree of attenuation. Certain conditions, such as inversions, can channel or focus the sound waves resulting in higher noise levels than would result from simple spherical spreading. The effects of meteorological conditions on sound levels are illustrated in Figure 2-2.

In addition to atmospheric absorption, aircraft noise can also be affected by the physical properties of the surrounding terrain. The magnitude of this terrain-related absorption varies with the angle of the aircraft above the horizon as measured from the observer to the aircraft. Lateral attenuation is influenced by ground reflection, refraction, aircraft shielding, and engine aircraft installation effects. In general, the lower an aircraft is, the greater the lateral attenuation. Lateral attenuation is not considered to be a factor if the angle between the observer and aircraft, as measured from the horizon, is greater than 60°. In this case, the aircraft is essentially overhead the observer.

Duration of Sound. Annoyance from a noise event rises with increased duration of the noise event, i.e., the longer the noise event, the more annoying it is. The "*effective duration*" of a sound is the time between when a sound rises above the background sound level until it drops back below the background level. Psycho-acoustic studies have determined the relationship between duration and annoyance and the amount a sound must be reduced to be judged equally annoying for increased duration. Duration is an important factor in describing sound in a community setting.

The relationship between duration and noise level is the basis of the equivalent energy principal of sound exposure. Reducing the acoustic energy of a sound by one-half results in a 3 dB reduction. Doubling the duration of the sound increases the total energy of the event by 3 dB. This equivalent energy principal is based upon the premise that the potential for a noise to impact a person is dependent on the total acoustical energy content of the noise.¹ Defined in subsequent sections of this study, noise metrics such as DNL, LEQ, and SEL are all based upon the equal energy principle.

Figure 2-1 Examples of Various Sound Environments in dB(A)

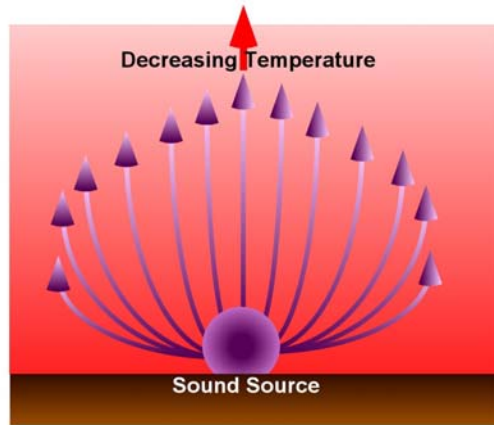
SOUND LEVELS AND LOUDNESS OF ILLUSTRATIVE NOISES IN INDOOR AND OUTDOOR ENVIRONMENTS
(A-Scale Weighted Sound Levels)

<i>dB(A)</i>	<i>OVER-ALL LEVEL Sound Pressure Level Reference: 0.0002 Microbars</i>	<i>COMMUNITY (Outdoor)</i>	<i>HOME OR INDUSTRY</i>	<i>LOUDNESS Human Judgement of Different Sound Levels</i>
130		Military Jet Aircraft Take-Off With After-burner From Aircraft Carrier @ 50 Ft. (130)	Oxygen Torch (121)	120 dB(A) 32 Times as Loud
120 110	UNCOMFORTABLY LOUD	Turbo-Fan Aircraft @ Take Off Power @ 200 Ft. (110)	Riveting Machine (110) Rock-N-Roll Band (108-114)	110 dB(A) 16 Times as Loud
100		Jet Flyover @ 1000 Ft. (103) Boeing 707, DC-8 @ 6080 Ft. Before Landing (106) Bell J-2A Helicopter @ 100 Ft. (100)		100 dB(A) 8 Times as Loud
90	VERY LOUD	Power Mower (96) Boeing 737, DC-9 @ 6080 Ft. Before Landing (97) Motorcycle @ 25 Ft. (90)	Newspaper Press (97)	90 dB(A) 4 Times as Loud
80		Car Wash @ 20 Ft. (89) Prop. Airplane Flyover @ 1000 Ft. (88) Diesel Truck, 40 MPH @ 50 Ft. (84) Diesel Train, 45 MPH @ 100 Ft. (83)	Food Blender (88) Milling Machine (85) Garbage Disposal (80)	80 dB(A) 2 Times as Loud
70	MODERATELY LOUD	High Urban Ambient Sound (80) Passenger Car, 65 MPH @ 25 Ft. (77) Freeway @ 50 Ft. From Pavement Edge, 10:00 AM (76 +or- 6)	Living Room Music (76) TV-Audio, Vacuum Cleaner	70 dB(A)
60		Air Conditioning Unit @ 100 Ft. (60)	Cash Register @ 10 Ft. (65-70) Electric Typewriter @ 10 Ft. (64) Dishwasher (Rinse) @ 10 Ft. (60) Conversation (60)	60 dB(A) 1/2 as Loud
50	QUIET	Large Transformers @ 100 Ft. (50)		50 dB(A) 1/4 as Loud
40		Bird Calls (44) Lower Limit Urban Ambient Sound (40)		40 dB(A) 1/8 as Loud
20	JUST AUDIBLE	Desert at Night (dB[A] Scale Interrupted)		
10	THRESHOLD OF HEARING			

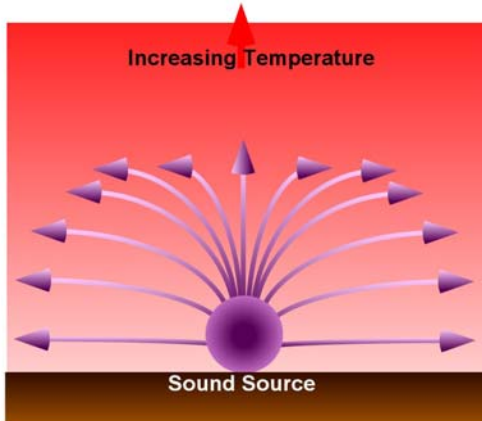
SOURCE: *Reproduced from Melville C. Branch and R. Dale Beland, "Outdoor Noise in the Metropolitan Environment," Published by the City of Los Angeles, 1970, p.2.*

Figure 2-2 Effects of Weather and Terrain on Sound Propagation

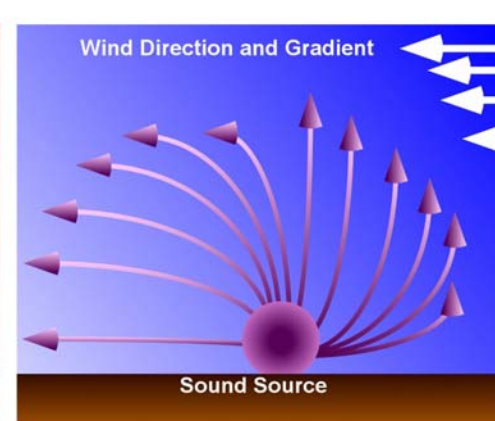
Refraction of sound in an atmosphere with a normal lapse rate. Sound rays are bent upwards.



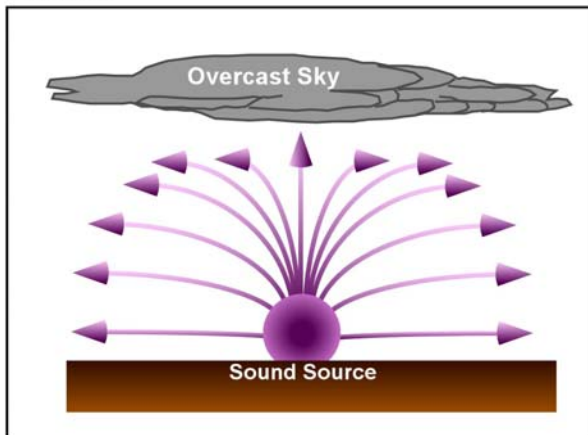
Refraction of sound in an atmosphere with an inverted lapse rate. Sound rays are bent downward.



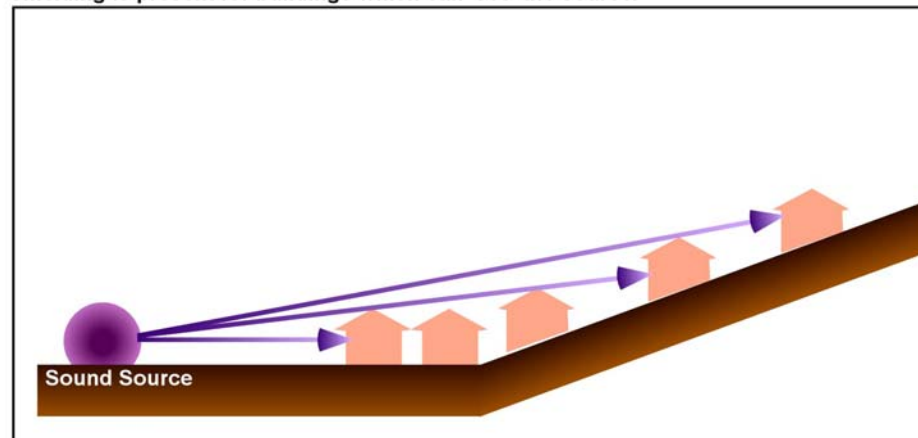
Refraction of sound in an atmosphere with a wind present. Sound rays are bent in the direction of the wind.



Refraction of sound in an atmosphere with overcast sky conditions. Sound rays are bent downward.



Propagation of sound over terrain. Ground absorption and shielding may be present for buildings at the same elevation as the source. No shielding is present for buildings which can 'see' the source.



Source: Adapted from Vancouver International Airport, Noise Management Report.

Change in Noise. The human ear is a far better detector of relative differences in sound levels than absolute values of levels. For this reason, the human ear is much better at discerning changes between differing noise levels than determining absolute noise levels. Under controlled laboratory conditions, listening to a steady unwavering pure tone sound that can be changed to slightly different sound levels, a person can just barely detect a sound level change of approximately one decibel for sounds in the mid-frequency region. When ordinary noises are heard, a young healthy ear can detect changes of two to three decibels. A five decibel change is readily noticeable, while a ten decibel change is judged by most people as a doubling or a halving of the loudness of the sound.

Masking Effect. The ability of one sound to prevent or limit a listener from hearing another sound is known as the masking effect. The presence of one sound effectively raises the threshold of audibility for the hearing of a second sound. For a signal to be heard, it must exceed the threshold of hearing for that particular individual and exceed the masking threshold for the background noise.

The masking characteristics of sound depend on many factors including the spectral (frequency) characteristics of the two sounds, the sound pressure levels, and the relative start time of the sounds. Masking effect is greatest when the frequencies of the two sounds are similar or when low frequency sounds mask higher frequency sounds. High frequency sounds do not easily mask low frequency sounds.

2.3 FACTORS INFLUENCING HUMAN RESPONSE TO SOUND

Many factors influence sound perception and annoyance. This includes not only physical characteristics of the sound but also secondary influences such as sociological and external factors. The *Handbook of Noise Control*ⁱⁱ describes human response to sound in terms of both acoustic and non-acoustic factors. These factors are summarized in Table 2-1.

Sound rating scales have been developed in reaction to the factors affecting human response to sound. Nearly all of these factors are relevant in describing how sounds are perceived in the community. Many non-acoustic parameters play a prominent role in affecting individual response to noise. Background sound, an additional acoustic factor not specifically listed, is also important in describing sound in rural settings. In the analysis of the effects of personal and situational variables on noise annoyance, a clear association of reported annoyance and various other individual perceptions or beliefs has been identified. Fieldsⁱⁱⁱ, in his analysis of the effects of personal and situational variables on noise annoyance, has identified a clear association of reported annoyance and various other individual perceptions or beliefs. In particular, Fields stated:

“There is therefore firm evidence that noise annoyance is associated with: (1) the fear of an aircraft crashing or of danger from nearby surface transportation; (2) the belief that aircraft noise could be prevented or reduced by designers, pilots or authorities related to airlines; and (3) an expressed sensitivity to noise generally.”

Thus, it is important to recognize that non-acoustic factors such as the ones described above as well as acoustic factors contribute to human response to noise.

Table 2-1 Factors that Affect Individual Annoyance to Noise

Primary Acoustic Factors

Sound Level
Frequency
Duration

Secondary Acoustic Factors

Spectral Complexity
Fluctuations in Sound Level
Fluctuations in Frequency
Rise-time of the Noise
Localization of Noise Source

Non-acoustic Factors

Physiology
Adaptation and Past Experience
How the Listener's Activity Affects Annoyance
Predictability of When a Noise will Occur
Is the Noise Necessary?
Individual Differences and Personality

Source: C. Harris, 1979

2.4 SOUND RATING SCALES

The description, analysis, and reporting of community sound levels, such as aircraft noise, is made difficult by the complexity of human response to sound and myriad sound-rating scales and metrics developed to describe acoustic effects. Various rating scales approximate the human subjective assessment to the "loudness" or "noisiness" of a sound. Noise metrics have been developed to account for additional parameters such as duration and cumulative effect of multiple events.

Noise metrics are categorized as single event metrics and cumulative metrics. Single event metrics describe the noise from individual events, such as one aircraft flyover. Cumulative metrics describe the noise in terms of the total noise exposure throughout the day. Below are brief descriptions of different noise metrics:

Single Event Metrics

Frequency Weighted Metrics (dBA). To simplify the measurement and computation of sound loudness levels, frequency weighted networks have obtained wide acceptance. The A-weighting (dBA) scale has become the most prominent of these scales and is widely used in community noise analysis. Its advantages are that it has shown good correlation with public response and is easily measured. The metrics used in this study are all based upon the dBA scale.

Maximum Noise Level (Lmax). The highest noise level reached during a noise event is, not surprisingly, called the "Maximum Noise Level," or Lmax. For example, as an aircraft approaches, the sound of the aircraft begins to rise above ambient noise levels. The closer the aircraft gets the louder it is until the aircraft is at its closest point directly overhead. Then as the aircraft passes, the noise level decreases until the sound level again settles to ambient levels. Such a history of a flyover is plotted at the top of Figure 2-3. It is this metric to which people generally instantaneously respond when an aircraft flyover occurs.

Sound Exposure Level (SEL). Another metric that is reported for aircraft flyovers is the Sound Exposure Level (SEL). It is computed from dBA sound levels. Referring again to the top of Figure 2-3, the shaded area, or the area within 10 dB of the maximum noise level, is the area from which the SEL is computed. The SEL value is the integration of all the acoustic energy contained within the event. Speech and sleep interference research can be assessed relative to single event Sound Exposure Level data.

The SEL metric takes into account the maximum noise level of the event and the duration of the event. For aircraft flyovers, the SEL value is typically about 10 dBA higher than the maximum noise level. Single event metrics are a convenient method for describing noise from individual aircraft events. This metric is useful in that airport noise models contain aircraft noise curve data based upon the SEL metric. In addition, cumulative noise metrics such as LEQ and DNL can be computed from SEL data.

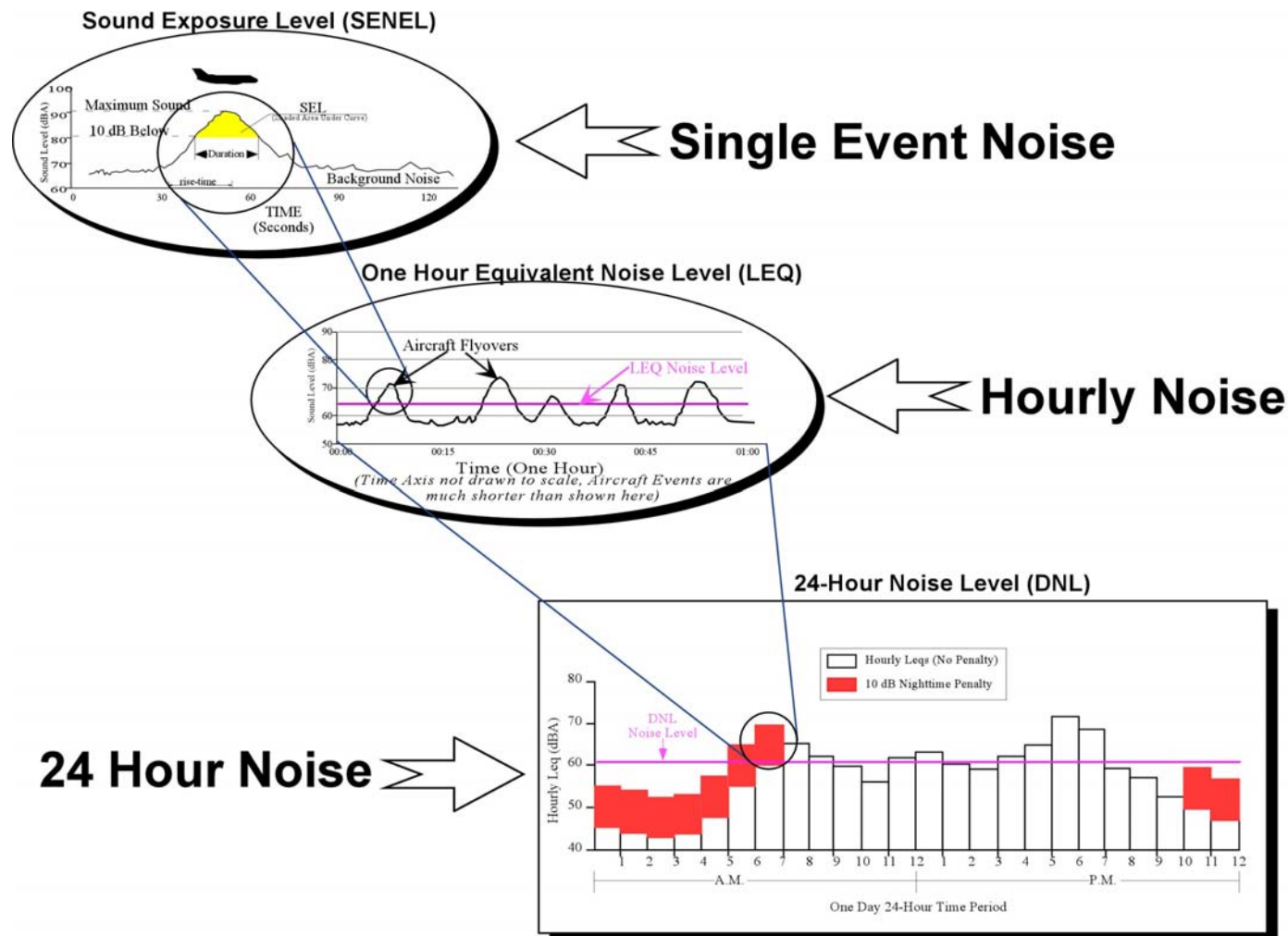
Cumulative Metrics

Cumulative noise metrics assess community response to noise by including the loudness of the noise, the duration of the noise, the total number of noise events and the time of day these events occur into one single number rating scale.

Equivalent Noise Level (Leq). Leq is the sound level corresponding to a steady-state A-weighted sound level containing the same total energy as several SEL events during a given sample period. Leq is the "energy" average noise level during the time period of the sample. It is based on the observation that the potential for noise annoyance is dependent on the total acoustical energy content of the noise. This is graphically illustrated in the middle graph of Figure 2-3. Leq can be measured for any time period, but is typically measured for 15 minutes, 1-hour, or 24-hours. .

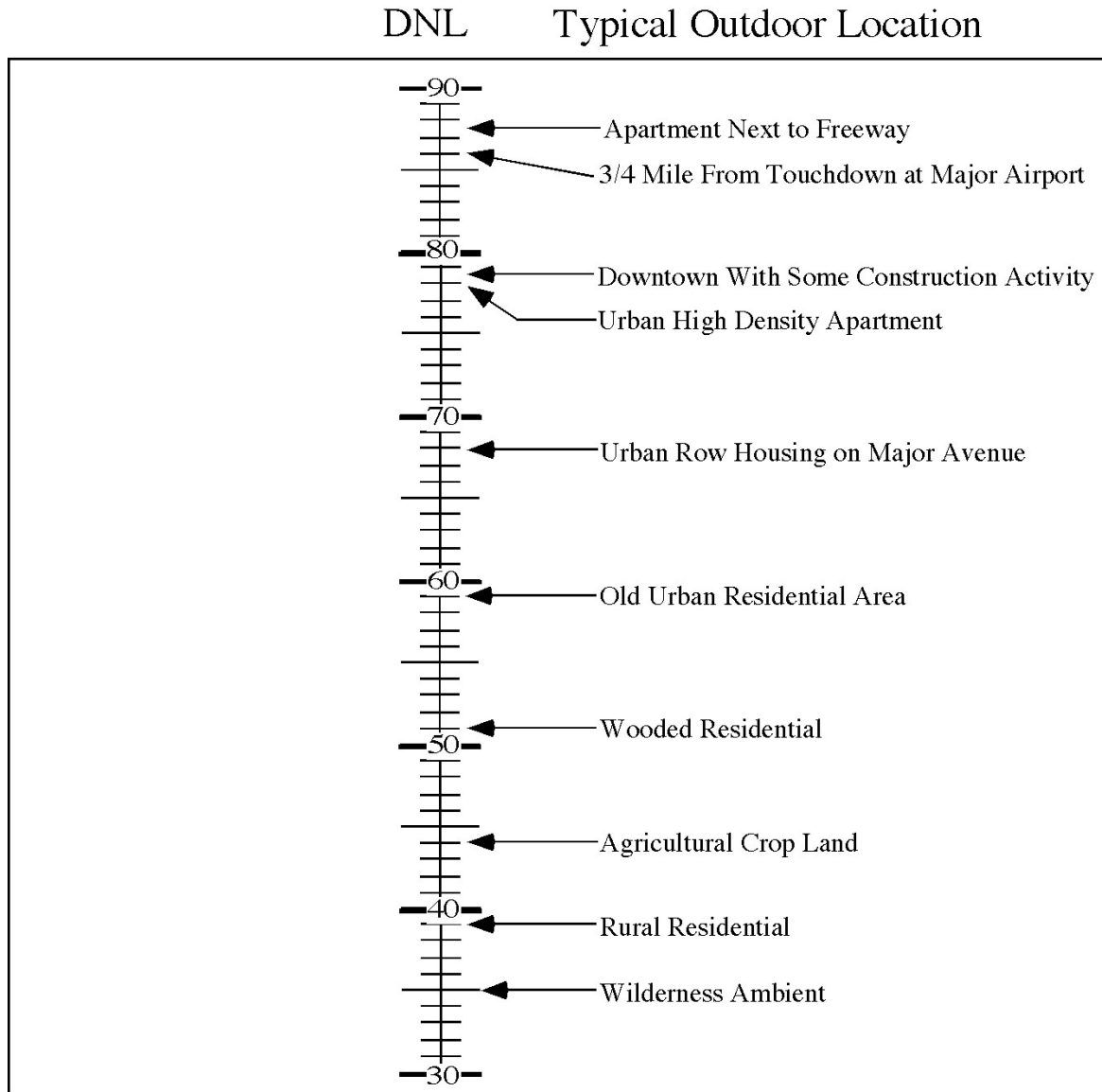
Day Night Noise Level (DNL). DNL is a 24-hour, time-weighted energy average noise level based on the A-weighted decibel. It is a measure of the overall noise experienced during an entire day. The term "time-weighted" refers to the weightings or penalties attached to noise events occurring during certain sensitive time periods. In the DNL scale, sound that takes place during the night (10 pm to 7 am) is weighted by 10 dB. This penalty accounts for the greater potential for noise to cause sleep awakening or communication interference during these hours, as well as typically lower ambient noise levels during these hours. This penalty was selected to attempt to account for the higher sensitivity to noise in the nighttime and the expected further decrease in background noise levels that typically occur during this period. DNL is required by the FAA for airport noise assessment and by the Environmental Protection Agency (EPA) for community noise and airport noise assessment. DNL is graphically illustrated in the bottom of Figure 2-3. Examples of various noise environments in terms of DNL are presented in Figure 2-4.

Figure 2-3 SEL, LEQ, LDN



Source: Mestres Greve Associates (1998)

Figure 2-4 Sound Levels in terms of DNL



Examples of Typical Outdoor DNL Levels

Source: Adapted from "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare With an Adequate Margin of Safety", EPA, 1974

2.5 EFFECTS OF NOISE ON HUMANS

Noise, often described as unwanted sound, is known to have several adverse effects on humans. From these known adverse effects of noise, criteria have been established to help protect the public health and safety and prevent disruption of certain human activities. These criteria are based on effects of noise on people such as hearing loss (not a factor with typical community noise), communication interference, sleep interference, physiological responses, and annoyance. Many of the impacts described in this section are described in greater detail in the *ACRP Synthesis 9, Effects of Aircraft Noise: Research Update on Selected Topics*^{xi}, published in 2008. Each of these potential noise impacts on people are briefly discussed in the following narrative:

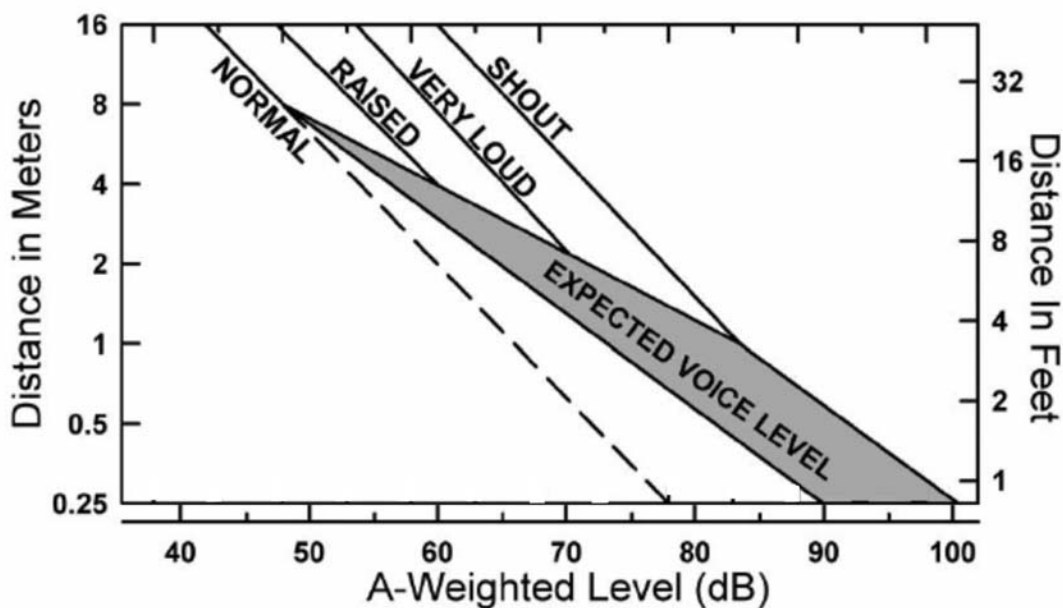
Hearing Loss is generally not a concern in community noise problems, even very near a major airport or a major freeway. Environmental noise does not have an effect on hearing threshold levels particularly due to the fact that environmental noise does not approximate occupational noise exposures in heavy industry, very noisy work environments with long-term exposure, or certain very loud recreational activities such as target shooting, motorcycle, or automobile racing, etc. The Occupational Safety and Health Administration (OSHA) identifies a noise exposure limit of 90 dBA for 8 hours per day to protect from hearing loss (higher limits are allowed for shorter duration exposures). Noise levels in neighborhoods, even in very noisy neighborhoods, are not sufficiently loud to cause hearing loss.

Communication Interference is one of the primary concerns in environmental noise problems. Communication interference includes speech interference and interference with activities such as watching television. Normal conversational speech is in the range of 60 to 65 dBA and any noise in this range or louder may interfere with speech. There are specific methods of describing speech interference as a function of distance between speaker and listener and voice level. Figure 2-5 shows the relation of quality of speech communication with respect to various noise levels.

Sleep Interference is a major noise concern in noise assessment and, of course, is most critical during nighttime hours. Sleep disturbance is one of the major causes of annoyance due to community noise. Noise can make it difficult to fall asleep, create momentary disturbances of natural sleep patterns by causing shifts from deep to lighter stages, and cause awakening. Noise may even cause awakening, which a person may or may not be able to recall.

Extensive research has been conducted on the effect of noise on sleep disturbance. Recommended values for desired sound levels in residential bedroom space range from 25 to 45 dBA with 35 to 40 dBA being the norm. Some years ago (1981), the National Association of Noise Control Officials^{iv} published data on the probability of sleep disturbance with various single event noise levels. Based on laboratory experiments conducted in the 1970's, this data indicated noise exposure at 75 dBA interior noise level event could cause noise induced awakening in 30 percent of the cases.

Figure 2-5 Speech Interference Levels

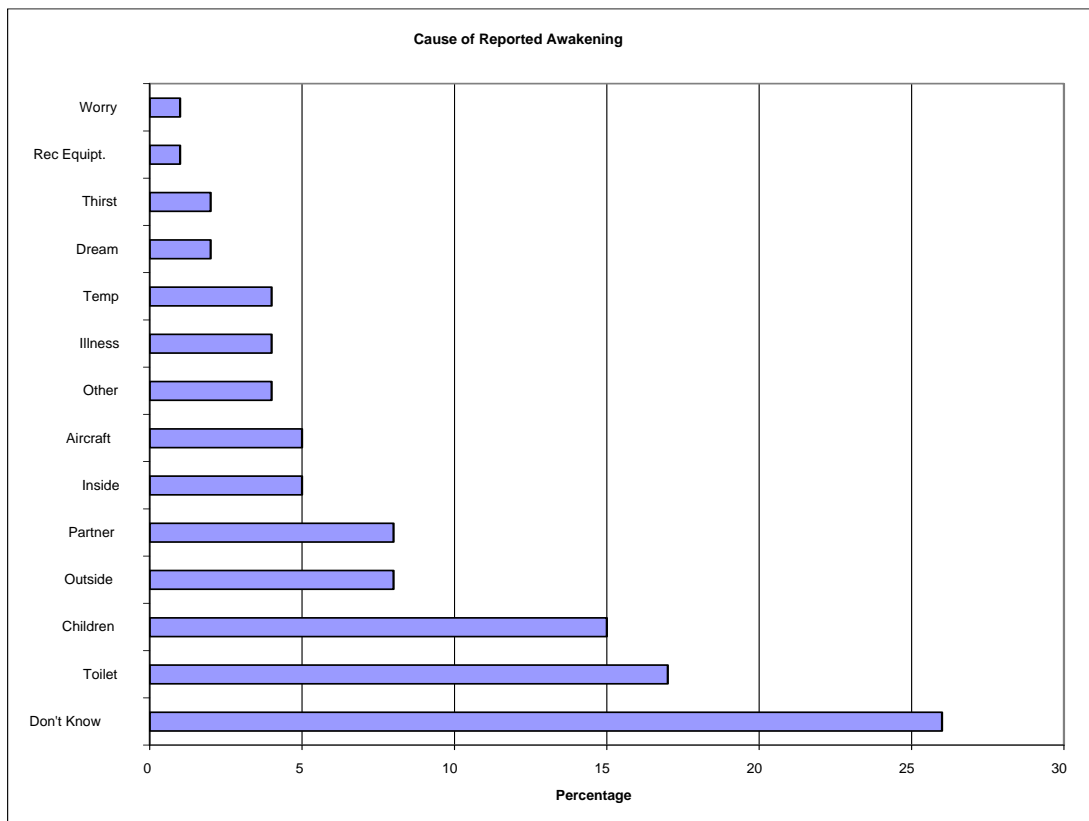


Source: U.S. EPA (1973)

However, more recent research from England^{v vi} has shown that the probability for sleep disturbance is less than what had been reported in earlier research. These recent field studies were conducted during the 1990's and used more sophisticated data collection techniques. These field studies indicate that awakenings can be expected at a much lower rate than had been expected based on earlier laboratory studies. This research showed that once a person was asleep, it is much more unlikely that they will be awakened by a noise. The significant difference in the recent English study is the use of actual in-home sleep disturbance patterns as opposed to laboratory data that had been the historic basis for predicting sleep disturbance. Some of this research has been criticized because it was conducted in areas where subjects had become habituated to aircraft noise. On the other hand, some of the earlier laboratory sleep studies were criticized because of the extremely small sample sizes of most laboratory studies and because the laboratory was not necessarily a representative sleep environment. The 1994 British sleep study compared the various causes of sleep disturbance using in home sleep studies. This field study assessed the effects of nighttime aircraft noise on sleep in 400 people (211 women and 189 men; 20-70 years of age; one per household) habitually living at eight sites adjacent to four U.K. airports, with different levels of night flying. The main finding was that only a minority of aircraft noise events affected sleep, and, for most subjects, that domestic and other non-aircraft factors had much greater effects. As shown in the Figure 2-6, aircraft noise was a minor contributor among a host of other factors that lead to awakening response.

Figure 2-6 Causes and Prevalence of All Awakenings

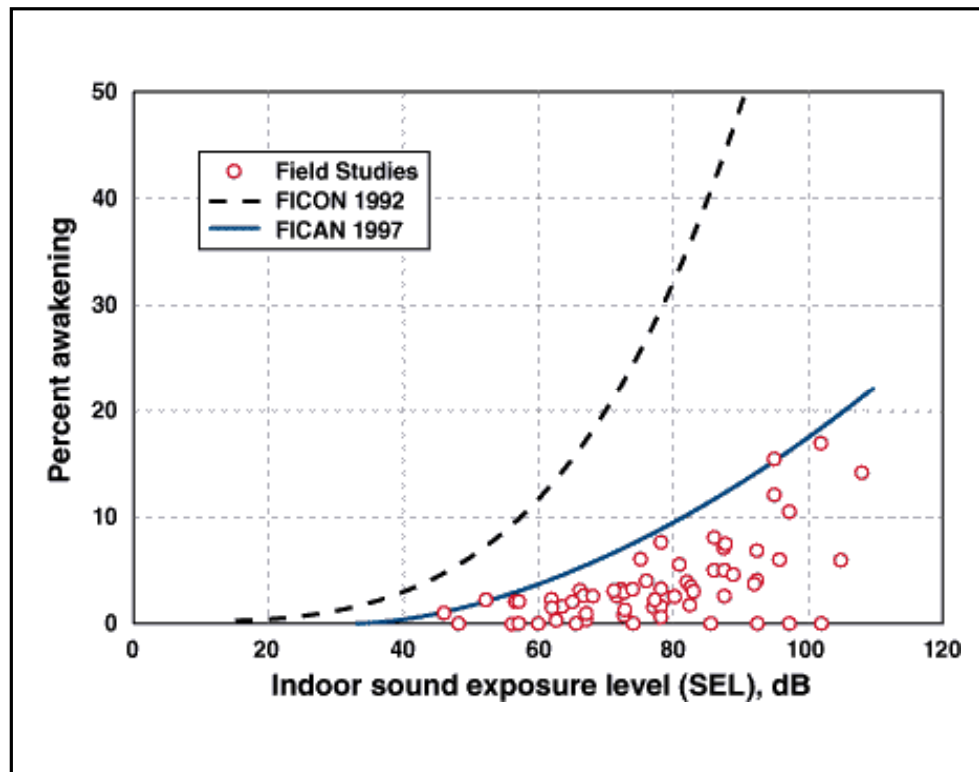
(Total awakenings = 6,457. Each subject could have reported more than one awakening each night.)



Source: Horne JA (1994)

The Federal Interagency Committee on Noise (FICON) in 1992 in a document entitled *Federal Interagency Review of Selected Airport Noise Analysis Issues*^{vii} recommended an interim dose-response curve for sleep disturbance based on laboratory studies of sleep disturbance. In June of 1997, the Federal Interagency Committee on Aviation Noise (FICAN) updated the FICON recommendation with an updated curve based on the more recent in-home sleep disturbance studies which show lower rates of awakening compared to the laboratory studies.^{viii} The FICAN recommended a curve based on the upper limit of the data presented and, therefore, considers the curve to represent the “maximum percent of the exposed population expected to be behaviorally awakened,” or the “maximum awakened.” The FICAN recommendation is shown on Figure 2-7. This is a very conservative approach. A more common statistical curve for the data points reflected in Figure 2-7, for example, would indicate a 10% awakening rate at a level of approximately 100 dB SEL, while the “maximum awakened” curve reflected in Figure 2-7 shows the 10% awakening rate being reached at 80 dB SEL. (The full FICAN report can be found on the internet at www.fican.org.)

Figure 2-7 FICAN Recommended Sleep Disturbance Curve



Source: FICAN (1997)

- *Physiological Responses* are those measurable effects of noise on people that are realized as changes in pulse rate, blood pressure, etc. While such effects can be induced and observed, the extent is not known to which these physiological responses cause harm or are a sign of harm. Generally, physiological responses are a reaction to a loud short-term noise such as a rifle shot or a very loud jet over flight.

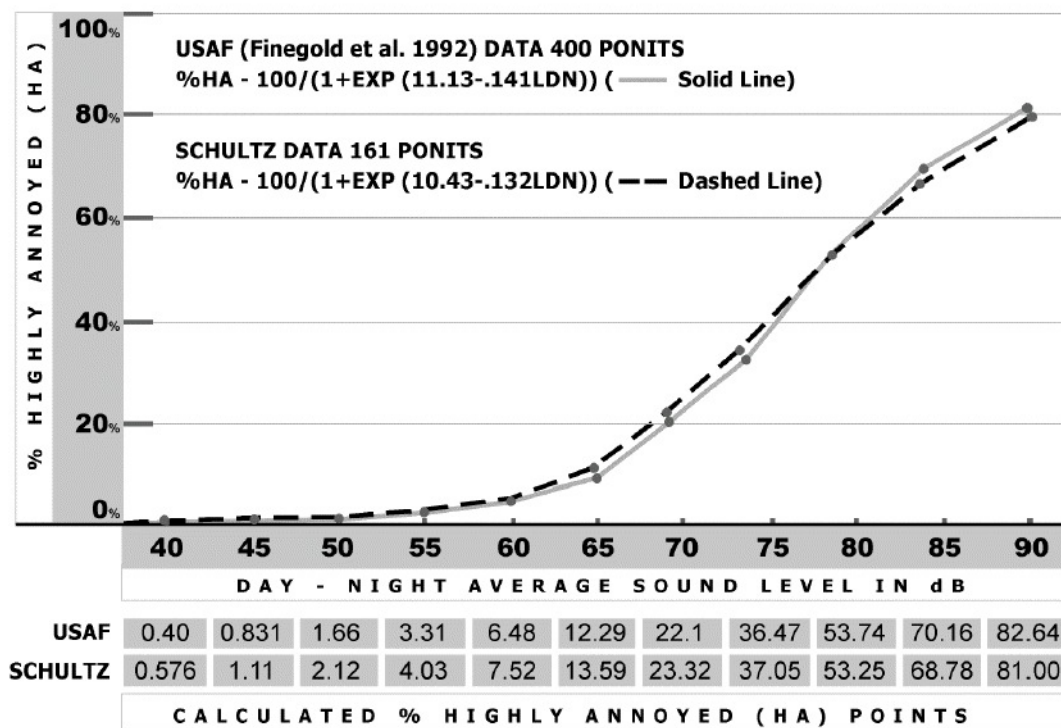
Health effects from noise have been studied around the world for nearly thirty years. Scientists have attempted to determine whether high noise levels can adversely affect human health apart from auditory damage. These research efforts have covered a broad range of potential impacts from cardiovascular response from fetal weight to mortality. While a relationship between noise and health effects seems plausible, it has yet to be convincingly demonstrated—that is, shown in a manner that can be repeated by other researchers while yielding similar results.

While annoyance and sleep/speech interference have been acknowledged, health effects, if they exist, are associated with a wide variety of other environmental stressors. Isolating the effects of aircraft noise alone as a source of long-term physiological change has proved to be nearly impossible. In a review of 30 studies conducted worldwide between 1993 and 1998,^{ix} a team of international researchers concluded that, while some findings suggest that noise can affect health, improved research concepts and methods are needed to verify or discredit such a relationship. They called for more study of the numerous environmental and behavioral factors than can confound, mediate, or moderate survey findings. Until science refines the research process, a direct link between aircraft noise exposure and non-auditory health effects remains to be demonstrated. Recent studies by Eriksson (2007) and Jarup (2007 HYENA study) have reported higher rates of hypertension with increasing aircraft noise levels. The Hyena study identified the effect occurred only for nighttime aircraft noise.

- *Annoyance* is the most difficult of all noise responses to describe. Annoyance is an individual characteristic and can vary widely from person to person. What one person considers tolerable can be quite unbearable to another of equal hearing capability. The level of annoyance, of course, depends on the characteristics of the noise (i.e.; loudness, frequency, time, and duration), and how much activity interference (e.g. speech interference and sleep interference) results from the noise. However, the level of annoyance is also a function of the attitude of the receiver. Personal sensitivity to noise varies widely. It has been estimated that two to ten percent of the population is highly susceptible to annoyance from any noise not of their own making, while approximately twenty percent are unaffected by noise. Attitudes are affected by the relationship between the person and the noise source (Is it our dog barking or the neighbor's dog?). Whether we believe that someone is trying to abate the noise will also affect our level of annoyance.

There is no current research to suggest that there is a better metric than DNL to relate to annoyance. Figure 2-8 relates DNL noise levels to community response from two of these surveys. One of the survey curves presented in Figure 2-8 is the well-known Schultz Curve. It displays the percent of a populace that can be expected to be annoyed by various DNL values for residential land use with outdoor activity areas. At 65 DNL, the Schultz Curve predicts approximately 14% of the exposed population reporting themselves to be “highly annoyed.” At 60 DNL, this decreases to approximately 8% of the population.

Figure 2-8 Schultz Curve



Source: FICON (1992)

The Schultz Curve and recent updates include data having a very wide range of scatter with communities near some airports reporting much higher percentages of population highly annoyed at these noise exposure levels. For example, under contract to the FAA, Bolt Beranek & Newman conducted community attitude surveys in the residential areas south of John Wayne Airport in Orange County in 1981 as part of a study of possible “power cutback” departure procedures. That study concluded that the surveyed population had more highly annoyed individuals at various noise levels than would be predicted by the Schultz Curve. When plotted similar to the Schultz Curve, this survey, indicated the populations in these areas were approximately 5 dB more sensitive to noise than the average population predicted by the Schultz Curve. While the precise reasons for this increased noise sensitivity were not identified, it is possible that non-acoustic factors, including political or the socio-economic status of the surveyed population may have played an important role in increasing the sensitivity of this community during the period of the survey. Annoyance levels have never been correlated statistically to single event noise exposure levels in airport related studies.

- *School Classroom Effects.* Interference with classroom activities and learning due to aircraft noise is an important consideration and has been the subject of much recent research. Studies from around the world indicate that vehicular traffic, railroad, and aircraft noise can have adverse effects on reading ability, concentration, motivation, and long-term learning retention. A complicating factor in this research is the extent of background noise from within the classroom itself. The studies indicating the most adverse effects examine cumulative noise levels equivalent to 65 DNL or higher and single event maximum noise levels ranging from 85 to 95 dBA. In other studies, the level of noise is unstated or ambiguous. According to these

studies, a variety of adverse school room effects can be expected from *interior* noise levels equal to or exceeding 65 DNL and or 85 dBA SEL.

Some interference with classroom activities can be expected with noise events that interfere with speech. As discussed in other sections of this report, speech interference begins at 65 dBA, which is the level of normal conversation. Typical construction attenuates outdoor noise by 20 dBA with windows closed and 12 dBA with windows open. Thus some interference of classroom activities can be expected at outdoor levels of 75 to 85 dBA. These levels are included in the Time Above analysis performed as part of this study. No studies have been identified where observations of student activity were compared to aircraft noise levels during aircraft flyovers. There is a clear need for additional research on the effects of aviation noise on schools and these studies need to include in classroom noise measurements and observation of student responses to aircraft activity.

2.6 AIRCRAFT NOISE POLICY CONTEXT

Noise metrics provide a means for quantifying public or community response to various noise exposure levels. The public reaction to different noise levels has been estimated from extensive research on human responses to exposure of different levels of aircraft noise. Noise standards generally are expressed in terms of the DNL 24-hour averaging scale based on the A-weighted decibel. Utilizing these metrics and surveys, agencies have developed guidelines for assessing the compatibility of various land uses with the noise environment. There are no single event noise based noise/land use compatibility criteria that have been adopted by the federal, state, or local governments.

This section presents information regarding noise and land use criteria useful in the evaluation of noise impacts. The Federal Aviation Administration has a long history of publishing noise/land use assessment criteria for airports. These laws and regulations provide the basis for local development of airport plans, analyses of airport impacts, and the enactment of compatibility policies. Other agencies including the EPA and the Department of Defense have developed noise/land use compatibility criteria. A summary of some of the more pertinent regulations and guidelines are presented in the following paragraphs.

Federal Aviation Administration

- **Federal Aviation Regulations, Part 36, "Noise Standards: Aircraft Type and Airworthiness Certification".**

Originally adopted in 1960, FAR Part 36 prescribes noise standards for issuance of new aircraft type certificates. Part 36 prescribes limiting noise levels for certification of new types of propeller-driven, small airplanes as well as for transport category, large airplanes. Subsequent amendments extended the standards to certain newly produced aircraft of older type designs. Other amendments have at various times extended the required compliance dates. Aircraft may be certificated as Stage 1, Stage 2, Stage 3, or Stage 4 aircraft based on their noise level, weight, number of engines, and in some cases, number of passengers. Higher Stage number certifications require quieter engines. All Stage 1 aircraft and Stage 2 aircraft weighing greater than 75,000 pounds are no longer permitted to operate in the U.S. Although aircraft meeting Part 36 standards are noticeably quieter than many of the older aircraft, the regulations make no determination that such aircraft are acceptably quiet for operation at any given airport or operation. The Stage 4 standard is intended to provide uniform noise certification standards for aircraft built in the U.S. to meet recent Civil Aviation Organization Annex 16 Chapter 4 noise standards.

- **U.S. Department of Transportation/FAA Aviation Noise Abatement Policy.**

This policy, adopted in 1976, sets forth the noise abatement authorities and responsibilities of the Federal Government, airport proprietors, state and local governments, the air carriers, air travelers and shippers, and airport area residents and prospective residents. The basic thought of the policy is that the FAA's role is primarily one of regulating noise at its source (the aircraft) plus supporting local efforts to develop airport noise abatement plans. The FAA will give high priority to projects designed to ensure compatible use of land near airports, but it is the role of state and local governments and airport proprietors to undertake the land use and operational actions necessary to

promote compatibility. In July 2000, the FAA proposed a draft-revised policy that has yet to be finalized. The draft can be found on the FAA's web site at:

http://www.aee.faa.gov/noise/aee100_files/fr_anap.pdf

- **Federal Aviation Regulations, Part 150, "Airport Noise Compatibility Planning".**

As a means of implementing the Aviation Safety and Noise Abatement Act, the FAA adopted Regulations on Airport Noise Compatibility Planning Programs. These regulations are spelled out in FAR Part 150. As part of the FAR Part 150 Noise Control program, the FAA published noise and land use compatibility charts to be used for land use planning with respect to aircraft noise. An expanded version of this chart appears in Aviation Circular 150/5020-1 (dated August 5, 1983) and is reproduced in Figure 2-9.

These guidelines represent recommendations to local authorities for determining acceptability and permissibility of land uses. The guidelines recommend a maximum amount of noise exposure (in terms of the cumulative noise metric DNL) that might be considered acceptable or compatible to people in living and working areas. These noise levels are derived from case histories involving aircraft noise problems at civilian and military airports and the resultant community response. Note that residential land use is deemed acceptable for noise exposures up to 65 DNL. Recreational areas are also considered acceptable for noise levels above 65 DNL (with certain exceptions for amphitheaters). However the FAA guidelines indicate that ultimately "the responsibility for determining the acceptability and permissible land uses remains with the local authorities."

- **Federal Aviation Order 5050.4B "Airport Environmental Handbook" and Order 1050.1E "Environmental Impacts: Policies and Procedures"**

The FAA has developed guidelines for conducting environmental studies to meet the requirements of the National Environmental Policy Act (NEPA). Included in the FAA orders is the requirement to evaluate aircraft noise using the DNL metric, as well as to present the impact of proposed airport actions, such as proposed airport development, in terms of the 65 DNL, 70 DNL, and 75 DNL noise contours. Further, these orders also indicate the threshold of project-related significant impacts. Federal requirements dictate that increases in noise levels caused by a federal action in noise sensitive land uses of over 1.5 DNL within 65 DNL are considered significant.

FAA Order 1050.1E states "Analysis within the DNL 60-65 dB contours to identify noise sensitive areas where noise will increase by DNL 3 dB, only when DNL 1.5 dB increases are documented within the DNL 65 dB contour." It is important to note that the 3 DNL increase is not a threshold of significance, but rather a disclosure of impact. A Desk Reference was published in 2007 that summarizes applicable special purpose laws to conveniently integrate all environmental review procedures that should be ran concurrently rather than consecutively.

- **Airport Noise and Capacity Act of 1990 (ANCA)**

The Airport Noise and Capacity Act of 1990 (PL 101-508, 104 Stat. 1388), also known as ANCA or the Noise Act, established two broad directives to the FAA: (1) Establish a method to review aircraft noise, airport use or airport access restrictions, imposed by airport proprietors; and (2) institute a program to phase-out Stage 2 aircraft over 75,000 pounds by December 31, 1999. Stage 2 aircraft are older, noisier aircraft (B-737-200, B-727 and DC-9); Stage 3 aircraft are newer, quieter

Figure 2-9 FAA Part 150 Land Use Compatibility Guidelines

Land Use	Yearly day-night average sound level (Ldn) in decibels					
	Below 65	65-70	70-75	75-80	80-85	Over 85
RESIDENTIAL						
Residential, other than mobile homes and transient lodging	Y	N(1)	N(1)	N	N	N
Mobile home parks	Y	N	N	N	N	N
Transient lodgings	Y	N(1)	N(1)	N(1)	N	N
PUBLIC USE						
Schools	Y	N(1)	N(1)	N	N	N
Hospitals and nursing homes	Y	25	30	N	N	N
Churches, auditoriums, and concert halls	Y	25	30	N	N	N
Government services	Y	Y	25	30	N	N
Transportation	Y	Y	Y(2)	Y(3)	Y(4)	Y(4)
Parking	Y	Y	Y(2)	Y(3)	Y(4)	N
COMMERCIAL USE						
Offices, business and professional	Y	Y	25	30	N	N
Wholesale and retail--building materials, hardware and farm equipment	Y	Y	Y(2)	Y(3)	Y(4)	N
Retail trade--general	Y	Y	25	30	N	N
Utilities	Y	Y	Y(2)	Y(3)	Y(4)	N
Communication	Y	Y	25	30	N	N
MANUFACTURING AND PRODUCTION						
Manufacturing, general	Y	Y	Y(2)	Y(3)	Y(4)	N
Photographic and optical	Y	Y	25	30	N	N
Agriculture (except livestock) and forestry	Y	Y(6)	Y(7)	Y(8)	Y(8)	Y(8)
Livestock farming and breeding	Y	Y(6)	Y(7)	N	N	N
Mining and fishing, resource production and extraction	Y	Y	Y	Y	Y	Y
RECREATIONAL						
Outdoor sports arenas and spectator sports	Y	Y(5)	Y(5)	N	N	N
Outdoor music shells, amphitheaters	Y	N	N	N	N	N
Nature exhibits and zoos	Y	Y	N	N	N	N
Amusements, parks, resorts, and camps	Y	Y	Y	N	N	N
Golf courses, riding stables and water recreation	Y	Y	25	30	N	N

Numbers in parenthesis refer to notes.

*The designations contained in this table do not constitute a Federal determination that any use of land covered by the program is acceptable or unacceptable under Federal, State, or local law. The responsibility for determining the acceptable and permissible land uses and the relationship between specific properties and specific noise contours rests with the local authorities. FAA determinations under Part 150 are not intended to substitute federally determined land uses for those determined to be appropriate by local authorities in response to locally determined needs and values in achieving noise compatible land uses.

Key to Table 1

SLUCM Standard Land Use Coding Manual.

Y (YES) Land Use and related structures compatible without restrictions.

N (No) Land Use and related structures are not compatible and should be prohibited.

NLR Noise Level Reduction (outdoor to indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure.

25, 30, or 35 Land use and related structures generally compatible; measures to achieve NLR of 25, 30 or 35 dB must be incorporated into design and construction of structure.

Notes for Table 1

(1) Where the community determines that residential or school uses must be allowed, measures to achieve outdoor to indoor Noise Level Reduction (NLR) of at least 25 dB and 30 dB should be incorporated into building codes and be considered in individual approvals. Normal residential construction can be expected to provide a NLR of 20 dB, thus, the reduction requirements are often stated as 5, 10 or 15 dB over standard construction and normally assume mechanical ventilation and closed windows year round. However, the use of NLR criteria will not eliminate outdoor noise problems.

(2) Measures to achieve NLR of 25 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

(3) Measures to achieve NLR of 30 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

(4) Measures to achieve NLR of 35 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

(5) Land use compatible provided special sound reinforcement systems are installed.

(6) Residential buildings require an NLR of 25.

(7) Residential buildings require an NLR of 30.

(8) Residential buildings not permitted.

Source: FAR Part 150

aircraft (B-737-300, B-757, MD80/90). To implement ANCA, FAA amended Part 91 and issued a new Part 161 of the Federal Aviation Regulations. Part 91 addresses the phase-out of large Stage 2 aircraft and the phase-in of Stage 3 aircraft. Part 161 establishes a stringent review and approval process for implementing use or access restrictions by airport proprietors.

Part 91 generally states that all Stage 2 aircraft, over 75,000 pounds, were to be out of the domestic fleet by December 31, 1999. For the most part, only Stage 3 aircraft greater than 75,000 pounds are currently in the domestic fleet.

Part 161 sets out the requirements and procedures for implementing new airport use and access restrictions by airport proprietors. Proprietors must use the DNL metric to measure noise effects and the Part 150 land use guideline table, including 65 DNL, as the threshold contour to determine compatibility, unless there is a locally adopted standard more stringent.

The regulation identifies three types of use restrictions and treats each one differently: (1) negotiated restrictions, (2) Stage 2 aircraft restrictions and (3) Stage 3 aircraft restrictions. Generally speaking, any use restriction affecting the number or times of aircraft operations will be considered an access restriction. Even though the Part 91 phase-out does not apply to aircraft under 75,000 pounds, FAA has determined that Part 161 limitations on proprietors' authority applies as well to the smaller aircraft.

Negotiated restrictions are more favorable from the FAA's standpoint, but still require unwieldy procedures for approval and implementation. In order to be effective the agreements normally must be agreed to by all airlines using an airport.

Stage 2 restrictions are more difficult, because one of the major reasons for ANCA was to discourage local restrictions more stringent than 1999 phase-out already contained in ANCA. To comply with the regulation and institute a new Stage 2 restriction, the proprietor must generally do two things. It must prepare a cost/benefit analysis of the proposed restriction and give proper notice. The cost/benefit analysis is extensive and entails considerable evaluation. Stage 2 restrictions primarily apply to Stage 2 aircraft weighing less than 75,000 pounds. These restrictions do not require approval by the FAA.

Stage 3 restrictions are even more difficult to implement. A Stage 3 restriction involves considerable additional analysis, justification, evaluation and financial discussion. In addition, a Stage 3 restriction must result in a decrease in noise exposure of the 65 dB DNL to noise sensitive land uses (residences, schools, churches, parks). The regulation requires both public notice and FAA approval.

Environmental Protection Agency

- **Environmental Protection Agency, "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety".**

In March 1974, in response to a federal statutory mandate, the EPA published this document¹ (EPA 550/9-74-004) describing 55 DNL as the requisite level with an adequate margin of safety for areas with outdoor uses, including residences and recreational areas. This document does not constitute EPA regulations or standards. Rather, it is intended to "provide State and Local governments as well as the Federal Government and the private sector with an informational point of departure for the

purpose of decision-making". Note that these levels were developed for suburban type uses. In some urban settings, the noise levels will be significantly above this level, while in some wilderness settings, the noise levels will be well below this level. The EPA "levels document" does not constitute a standard, specification or regulation, but identifies safe levels of environmental noise exposure without consideration for achieving these levels or other potentially relevant considerations.

3.0 METHODOLOGY

The methods used here for describing baseline noise and forecasting the future noise environment rely extensively computer noise modeling. The noise environment is commonly depicted in terms of lines of equal noise levels, or noise contours. These noise contours are supplemented here with specific noise data for selected points on the ground.

The FAA's Integrated Noise Model (INM) Version 7.0a^x was used to model aviation operations for Kodiak Airport for purposes of identifying the extent of aircraft noise exposure. The original INM was released in 1977. The latest version, INM Version 7.0a, was released for use in 2008, and is the state-of-the-art in airport noise modeling. The INM is a large computer program developed to plot noise contours for airports. The program is provided with standard aircraft noise and performance data for over 100 civilian aircraft types that can be tailored to the characteristics of an airport, as well as a database of military aircraft types. Version 7.0a includes an updated database that includes some newer aircraft, the ability to include run-ups in the computations, the ability to include topography in the computations, and the increased differentiation between different types of aircraft (civil, military, and helicopter).

The INM program requires the input of the physical and operational characteristics of an airport. Physical characteristics include runway coordinates, airport altitude, and temperature and optionally, topographical data. Operational characteristics include various types of aircraft data. This includes not only the aircraft types and flight tracks, but also departure procedures, arrival procedures, and stage lengths (flight distance) that are specific to the operations at an airport. Aircraft data needed to generate noise contours include:

- Number of aircraft operations by type
- Types of aircraft
- Day/Night time distribution by type
- Flight tracks
- Flight track and runway utilization by type
- Flight profiles
- Typical operational procedures
- Average Meteorological Conditions

The following sections describe the data used in generating existing and future aircraft noise exposure contours.

4.0 BASELINE NOISE CONDITIONS

4.1 BACKGROUND

The purpose of this section is to document the analysis of the base year noise environment at Kodiak Airport (ADQ). For purposes of noise analysis and comparison, operations data for the calendar year 2007 were analyzed as the baseline conditions for this study. At the time of preparation of this report, this period was the latest twelve-month period for which reliable operations information was available. This period serves as the baseline noise environment and provides a reference point from which changes to the noise environment may be assessed. For purposes of identification, this period will be referenced as Baseline 2007.

4.2 BASELINE 2007 OPERATIONS AND FLEET MIX

ADQ serves scheduled commercial passenger airline and cargo operations, general aviation operations, and military (US Coast Guard) operations. The operations for the year 2007 are summarized below in Table 4-1.

Table 4-1 Aircraft Operations And Passenger Enplanements

Category	Baseline 2007 Operations
Air Carrier	1,350
Air Taxi and Commuter	18,830
General Aviation	1,155
Military	2,056
Touch & Go (General Aviation)	1,196
Touch & Go (Military)	11,036
Total Operations	35,623
Passenger Enplanements	80,658

Source: Kodiak Airport FAA Air Traffic Tower, Mestre Greve Associates (2009)

Table 4-1 indicates that 18,830 or 53% of total operations were conducted by Air Taxi and Commuter aircraft. Air Taxi and Commuter operations include small single engine aircraft as well larger twin engine aircraft. These operations are associated with aerial tours provided at the airport and include many aircraft types such as the G44, PA31, BN2 and C207.

The second most numerous operations at ADQ are operations by the United States Coast Guard (USCG) aircraft performing Touch and Go operations. The USCG aircraft stationed at ADQ include the C130 fixed-wing aircraft and the HH60 and HH65 helicopters. The third most numerous operations at ADQ are Itinerant operations by the USCG aircraft, which include Search and Rescue operations.

Aircraft operations and fleet mix are important components of this analysis as cumulative noise levels in the environs of ADQ are a function of the loudness of the aircraft and the number of aircraft operations. Air carrier operations are the most important determinant of cumulative noise levels as air carrier aircraft are among the loudest aircraft operating at the airport. Of the 35,623 total operations occurring at Kodiak Airport during the baseline year, 1,350 or 4% were air carrier operations.

In terms of noise exposure, two sub-categories of air carrier aircraft are important for analysis. These sub-categories are the Stage 2 and Stage 3 aircraft classifications as determined by Federal Aviation Regulation Part 36. Stage 2 aircraft are older, louder aircraft. These air carrier aircraft did not operate from the airport during the baseline year 2007. Stage 2 aircraft weighing more than 75,000 pounds are prohibited in the contiguous U. S. except under special conditions such as maintenance work on foreign aircraft; however, several aircraft types that were originally manufactured as Stage 2 aircraft and have since been retro-fitted with engines or engine components that enable them to meet Stage 3 standards operated scheduled service from the airport during the baseline year. These aircraft are termed "hush-kit" aircraft. These aircraft include the B727, the B737-200, DC-8, and the DC-9 aircraft.

Detailed operations data is maintained for Air Carrier operations. However, information regarding specific aircraft types within the Air Taxi/Commuter, General Aviation and Military categories was estimated with the assistance of ADQ ATCT personnel. A summary of ADQ Baseline operations for each aircraft type is shown in Table 4-2. These data were used for input into the INM for development of the 2007 noise contour.

Table 4-2 Aircraft Operations By Aircraft Type – Baseline 2007

Jet	
737-400	1,159
737-200	191
F28	93
C500	96
FA50	90
C550	96
LEAR35	97
GLF3	90
GLF5	90
SUBTOTAL	2,002
Propeller	
DASH 8/Q200	2,894
SW4	721
B190	721
C207	1,822
PA31	1,822
BN2	2,734
C206	2,039
DHC2	2,039
PA32	2,729
G44	960
DC6	256
C172	299
PA18	1,493
C130	2,594
SUBTOTAL	23,123
Helicopter	
HH60	5,249
HH65	5,249
SUBTOTAL	10,498
TOTAL OPERATIONS	35,623

Source: Kodiak Airport FAA Air Traffic Tower, Mestre Greve Associates (2009)

4.3 RUNWAYS AND FLIGHT TRACKS

Flight tracks refer to the actual tracks projected over the ground used by aircraft for arrival or departure to/from the Airport. Flight tracks are obviously related to runway utilization and are a large factor in determining the shape of the noise contours. These data are critical

to the noise analysis as cumulative noise metrics such as DNL are based upon the total noise exposure occurring during a 24-hour period. Safety considerations, airport layout, aircraft performance, runway length requirements, direction of destination and meteorological conditions influence the runway utilization at ADQ. These considerations are discussed in detail in the following paragraphs.

Runway Utilization

Runway utilization refers to the percentage of total arrival or departure operations occurring on a specific runway. Runway utilization is determined by several factors including runway length, proximity to the terminal, and meteorological conditions as well as the performance capabilities of specific aircraft.

Runway utilization is greatly influenced by meteorological conditions. For safety reasons, aircraft take off and land into the prevailing wind. This practice results in reduced groundspeed and greater safety margins for each of these operations. The wind direction at ADQ changes frequently, but allows utilization to be divided fairly evenly amongst all runways. However, there are minimal arrivals into Runway 7 and departures from Runway 25 due to the proximity of Barometer Mountain.

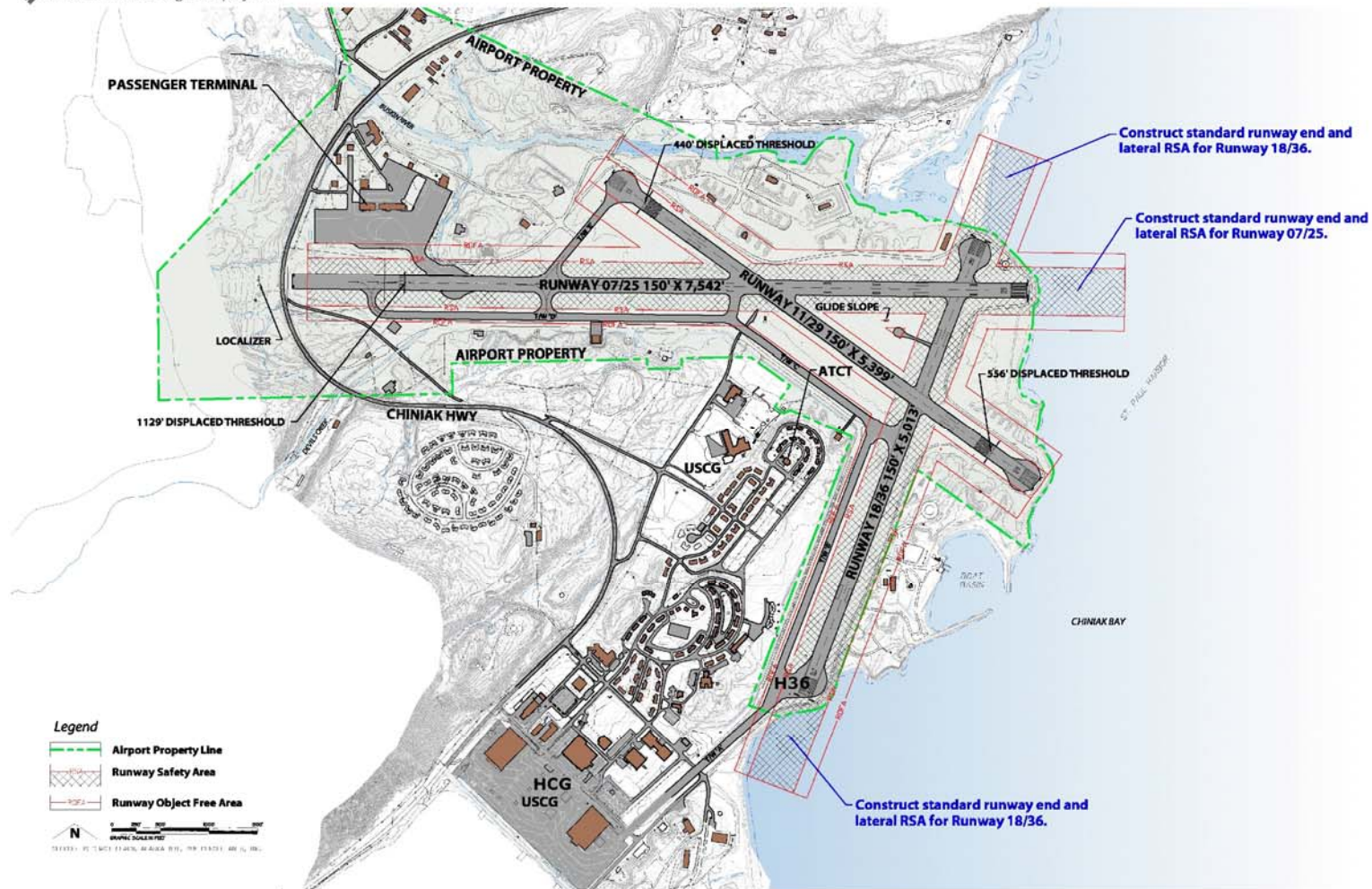
The physical characteristics of the airport layout are another important factor influencing runway utilization. These characteristics include the length and orientation of the runways and terminal location with respect to the runways. The runway layout for Kodiak Airport is shown in Figure 4-1. Runways are identified by reference to the direction of heading referenced to magnetic north rounded to the nearest 10 degrees. For example, an aircraft taking off or landing on Runway 29 have a magnetic heading of approximately 290 degrees.

The runways at ADQ vary in length. Runway 7/25 is 7,542 feet in length. Runway 11/29 is 5,399 feet in length. Runway 18/36 is 5,013 feet in length. Additionally, the USCG helicopters use helipads located near the beginning of Runway 36 (H36) and near the USCG facilities (HCG).

Pilots generally prefer to use the longer runways for safety considerations and aircraft performance capabilities and meteorological conditions may dictate the use of a specific runway. Air Carrier operations for example, primarily use the longest runway (Runway 7/25). Terminal proximity and direction of arrival or departure are secondary considerations that influence runway utilization. Assuming safety considerations are met, pilots prefer to use the most expeditious runway and route of flight. At ADQ, these considerations favor the use of Runway 7/25 for Air Carrier, Air Taxi/Commuter, and General Aviation operations. USCG C130 Touch and Go operations predominantly take place on Runways 36 and 29.

Figure 4-1 Kodiak Airport Airfield Layout

» The Barnard Dunkelberg & Company Team



Discussions with FAA Air Traffic Control Tower (ATCT) personnel were used to determine runway use for the Airport. Time of day of operations is critical for determining DNL as operations occurring between the hours of 10:00 pm and 7:00 am are weighted by 10 dB. Tables 4-3 through 4-6 depict the percent of use by aircraft operation, time of day, and primary aircraft types. Tables 4-3 and 4-4 depict day and night¹ departure use of the existing runway system. Tables 4-5 and 4-6 depict day and night arrival allocation and Table 4-7 lists the Touch and Go allocation.

Table 4-3 Daytime (7:00 am - 10:00 pm) Departure Runway Use – Baseline 2007

Aircraft Type	Runway 7	Runway 25	Runway 11	Runway 29	Runway 18	Runway 36	H36	HCG
737-400	50%	-	-	-	25%	25%	-	-
737-200	50%	-	-	-	25%	25%	-	-
F28	50%	-	-	-	25%	25%	-	-
C500	50%	-	-	-	25%	25%	-	-
FA50	50%	-	-	-	25%	25%	-	-
C550	50%	-	-	-	25%	25%	-	-
LEAR35	50%	-	-	-	25%	25%	-	-
GLF3	50%	-	-	-	25%	25%	-	-
GLF5	50%	-	-	-	25%	25%	-	-
DASH 8/Q200	50%	-	-	-	25%	25%	-	-
SW4	50%	-	-	-	25%	25%	-	-
B190	50%	-	-	-	25%	25%	-	-
C207	50%	-	-	-	25%	25%	-	-
PA31	50%	-	-	-	25%	25%	-	-
BN2	50%	-	-	-	25%	25%	-	-
C206	50%	-	-	-	25%	25%	-	-
DHC2	50%	-	-	-	25%	25%	-	-
PA32	50%	-	-	-	25%	25%	-	-
G44	50%	-	-	-	25%	25%	-	-
DC6	50%	-	-	-	25%	25%	-	-
C172	50%	-	-	-	25%	25%	-	-
PA18	50%	-	-	-	25%	25%	-	-
C130	50%	-	-	-	25%	25%	-	-
HH60	-	-	-	-	-	-	50%	50%
HH65	-	-	-	-	-	-	50%	50%

Source: Kodiak Airport FAA Air Traffic Tower, Mestre Greve Associates (2009)

¹ Daytime operations occur between 7:00 am and 10:00 pm. Nighttime operations occur between 10:00 pm and 7:00 am.

Table 4-4 Nighttime (10:00 pm - 7:00 am) Departure Runway Use – Baseline 2007

Aircraft Type	Runway 7	Runway 25	Runway 11	Runway 29	Runway 18	Runway 36	H36	HCG
737-400	50%	-	-	-	25%	25%	-	-
737-200	50%	-	-	-	25%	25%	-	-
F28	50%	-	-	-	25%	25%	-	-
C500	50%	-	-	-	25%	25%	-	-
FA50	50%	-	-	-	25%	25%	-	-
C550	50%	-	-	-	25%	25%	-	-
LEAR35	50%	-	-	-	25%	25%	-	-
GLF3	50%	-	-	-	25%	25%	-	-
GLF5	50%	-	-	-	25%	25%	-	-
DASH 8/Q200	50%	-	-	-	25%	25%	-	-
SW4	50%	-	-	-	25%	25%	-	-
B190	50%	-	-	-	25%	25%	-	-
C207	50%	-	-	-	25%	25%	-	-
PA31	50%	-	-	-	25%	25%	-	-
BN2	50%	-	-	-	25%	25%	-	-
C206	50%	-	-	-	25%	25%	-	-
DHC2	50%	-	-	-	25%	25%	-	-
PA32	50%	-	-	-	25%	25%	-	-
G44	50%	-	-	-	25%	25%	-	-
DC6	50%	-	-	-	25%	25%	-	-
C172	50%	-	-	-	25%	25%	-	-
PA18	50%	-	-	-	25%	25%	-	-
C130	50%	-	-	-	25%	25%	-	-
HH60	-	-	-	-	-	-	50%	50%
HH65	-	-	-	-	-	-	50%	50%

Source: Kodiak Airport FAA Air Traffic Tower, Mestre Greve Associates (2009)

Table 4-5 Daytime (7:00 am - 10:00 pm) Arrival Runway Use – Baseline 2007

Aircraft Type	Runway 7	Runway 25	Runway 11	Runway 29	Runway 18	Runway 36	H36	HCG
737-400	-	50%	25%	25%	-	-	-	-
737-200	-	50%	25%	25%	-	-	-	-
F28	-	50%	25%	25%	-	-	-	-
C500	-	50%	25%	25%	-	-	-	-
FA50	-	50%	25%	25%	-	-	-	-
C550	-	50%	25%	25%	-	-	-	-
LEAR35	-	50%	25%	25%	-	-	-	-
GLF3	-	50%	25%	25%	-	-	-	-
GLF5	-	50%	25%	25%	-	-	-	-
DASH 8/Q200	-	50%	25%	25%	-	-	-	-
SW4	-	50%	25%	25%	-	-	-	-
B190	-	50%	25%	25%	-	-	-	-
C207	-	50%	25%	25%	-	-	-	-
PA31	-	50%	25%	25%	-	-	-	-
BN2	-	50%	25%	25%	-	-	-	-
C206	-	50%	25%	25%	-	-	-	-
DHC2	-	50%	25%	25%	-	-	-	-
PA32	-	50%	25%	25%	-	-	-	-
G44	-	50%	25%	25%	-	-	-	-
DC6	-	50%	25%	25%	-	-	-	-
C172	-	50%	25%	25%	-	-	-	-
PA18	-	50%	25%	25%	-	-	-	-
C130	-	50%	25%	25%	-	-	-	-
HH60	-	-	-	-	-	-	50%	50%
HH65	-	-	-	-	-	-	50%	50%

Source: Kodiak Airport FAA Air Traffic Tower, Mestre Greve Associates (2009)

Table 4-6 Nighttime (10:00 pm - 7:00 am) Arrival Runway Use – Baseline 2007

Aircraft Type	Runway 7	Runway 25	Runway 11	Runway 29	Runway 18	Runway 36	H36	HCG
737-400	-	50%	25%	25%	-	-	-	-
737-200	-	50%	25%	25%	-	-	-	-
F28	-	50%	25%	25%	-	-	-	-
C500	-	50%	25%	25%	-	-	-	-
FA50	-	50%	25%	25%	-	-	-	-
C550	-	50%	25%	25%	-	-	-	-
LEAR35	-	50%	25%	25%	-	-	-	-
GLF3	-	50%	25%	25%	-	-	-	-
GLF5	-	50%	25%	25%	-	-	-	-
DASH 8/Q200	-	50%	25%	25%	-	-	-	-
SW4	-	50%	25%	25%	-	-	-	-
B190	-	50%	25%	25%	-	-	-	-
C207	-	50%	25%	25%	-	-	-	-
PA31	-	50%	25%	25%	-	-	-	-
BN2	-	50%	25%	25%	-	-	-	-
C206	-	50%	25%	25%	-	-	-	-
DHC2	-	50%	25%	25%	-	-	-	-
PA32	-	50%	25%	25%	-	-	-	-
G44	-	50%	25%	25%	-	-	-	-
DC6	-	50%	25%	25%	-	-	-	-
C172	-	50%	25%	25%	-	-	-	-
PA18	-	50%	25%	25%	-	-	-	-
C130	-	50%	25%	25%	-	-	-	-
HH60	-	-	-	-	-	-	50%	50%
HH65	-	-	-	-	-	-	50%	50%

Source: Kodiak Airport FAA Air Traffic Tower, Mestre Greve Associates (2009)

Table 4-7 Touch and Go Runway Use – Baseline 2007

Aircraft Type	Runway 7	Runway 25	Runway 11	Runway 29	Runway 18	Runway 36	H36	HCG
C130	-	-	5%	45%	5%	45%	-	-
HH60	-	-	5%	45%	5%	45%	-	-
HH65	-	-	5%	45%	5%	45%	-	-

Source: Kodiak Airport FAA Air Traffic Tower, Mestre Greve Associates (2009)

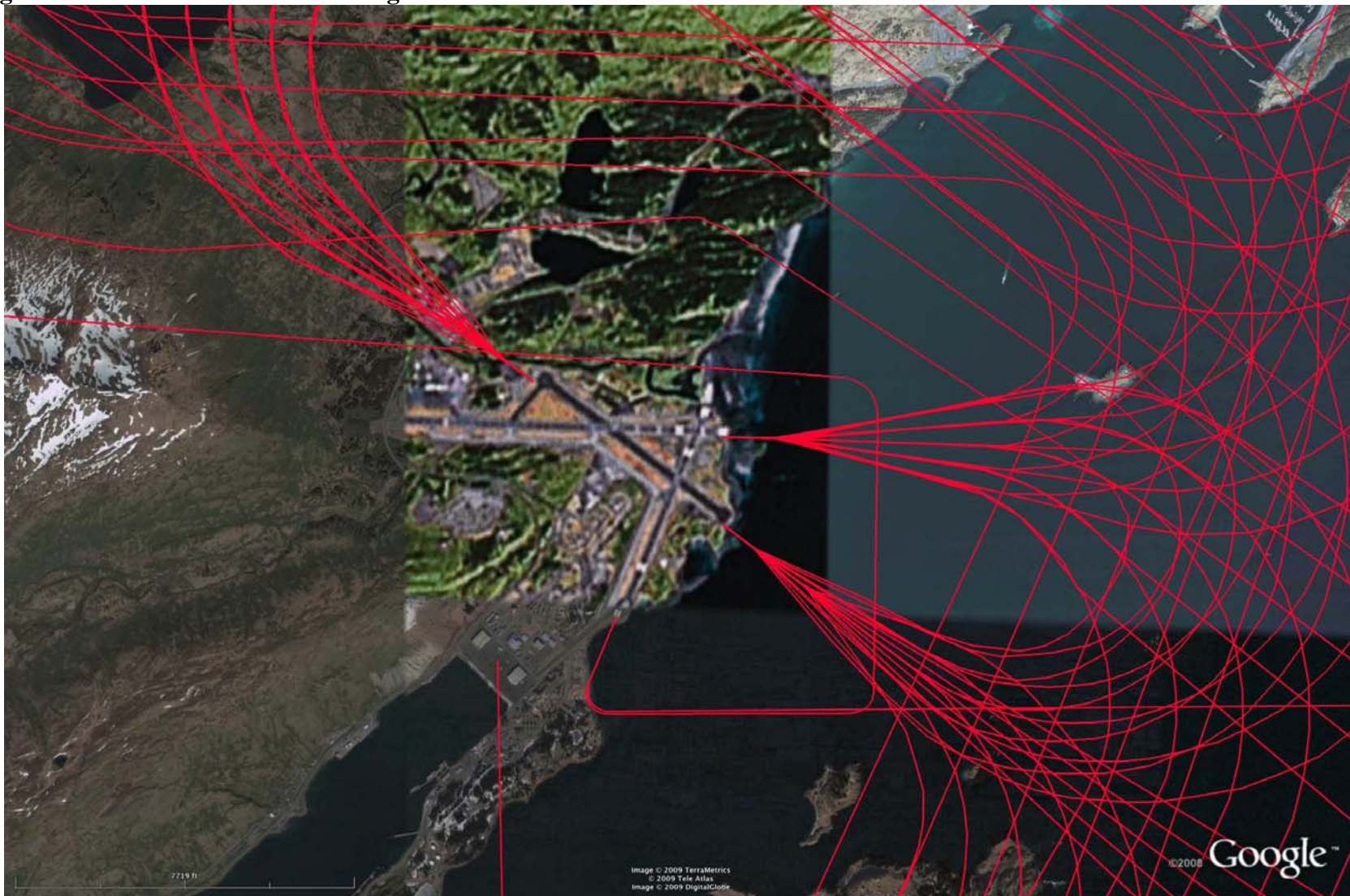
The data shown in these tables was derived from discussions with ATCT personnel. These tables indicate that Runway 7/25 is the most used runway for arrivals and departures; however, when adding the USCG Touch and Go operations, Runways 29 and 36 become the most utilized.

Flight Tracks

The FAA has established paths for aircraft arriving to and departing from ADQ. These paths are not precisely defined ground tracks, but represent a broad area over which the aircraft generally fly. To determine the location of these tracks, discussions with ATCT

personnel and aircraft operators were obtained and analyzed for input into the INM. The resulting flight tracks are representative of the most common flight tracks used at the Airport. These tracks are not inclusive of all paths used by aircraft as they are designed to represent the most common paths used by aircraft arriving and departing the Airport. For purposes of noise prediction and analysis, including determination of cumulative noise exposure levels, the flight tracks presented in this study accurately reflect all flight operations. These flight tracks are shown in Figures 4-2a and 4-2b. Figure 4-2a depicts arrival tracks and Figure 4-2b depicts departure tracks.

Figure 4-2a Baseline 2007 Arrival Flight Track



Source: Kodiak Airport FAA Air Traffic Tower, Mestre Greve Associates (2009)

Figure 4-2b Baseline 2007 Departure Flight Tracks



Source: Kodiak Airport FAA Air Traffic Tower, Mestre Greve Associates (2009)

4.4 TIME OF DAY

In the DNL metric, any operations that occur after 10 p.m. and before 7 a.m. are considered more intrusive and are weighted by 10 dBA. This result of this mathematical weighting is that in terms of DNL calculation, one night operation is equivalent to ten (10) daytime operations. Therefore, the percentage of nighttime operations has a large influence on the DNL noise contours. Analysis was conducted to determine the actual time of day of each operation at Kodiak Airport. The number of nighttime operations for each type of aircraft was determined from discussions with ATCT personnel. This data is presented in Table 4-7

Table 4-7 Aircraft Operations By Day/Night Period – Baseline 2007

Aircraft Type	Departures		Arrivals	
	% Day	% Night	% Day	% Night
737-400	95%	5%	95%	5%
737-200	63%	37%	63%	37%
F28	95%	5%	95%	5%
C500	95%	5%	95%	5%
FA50	95%	5%	95%	5%
C550	95%	5%	95%	5%
LEAR35	95%	5%	95%	5%
GLF3	95%	5%	95%	5%
GLF5	95%	5%	95%	5%
DASH 8/Q200	95%	5%	95%	5%
SW4	95%	5%	95%	5%
B190	95%	5%	95%	5%
C207	95%	5%	95%	5%
PA31	95%	5%	95%	5%
BN2	95%	5%	95%	5%
C206	95%	5%	95%	5%
DHC2	95%	5%	95%	5%
PA32	95%	5%	95%	5%
G44	95%	5%	95%	5%
DC6	38%	62%	38%	62%
C172	95%	5%	95%	5%
PA18	95%	5%	95%	5%
C130	95%	5%	95%	5%
HH60	95%	5%	95%	5%
HH65	95%	5%	95%	5%

Source: Kodiak Airport FAA Air Traffic Tower, Mestre Greve Associates (2009)

According to ATCT, it is difficult to calculate exact runway utilization, time of day, and flight track location due to available means to gather such information. Please note that the above operational information is estimated as best as possible.

4.5 STAGE LENGTH

Stage length refers to the distance of aircraft travel for each departure from the Airport to a destination city (i.e., the air distance from ADQ to Anchorage is approximately 230 nautical miles). In noise modeling practice, stage length is a surrogate for aircraft departure weight. Aircraft departure weight is important, as noise levels are higher for heavier aircraft of a given type. This is due to the decreased climb performance and higher thrust settings required by heavier aircraft. These factors do not apply to arriving aircraft. Table 4-8 indicates the percentage of departures by stage length for each major aircraft type.

Table 4-8 Percent of Departures By Stage Length – Baseline 2007

Aircraft Type	Stage 1 (0-500nm)
737-400	100%
737-200	100%
F28	100%
C500	100%
FA50	100%
C550	100%
LEAR35	100%
GLF3	100%
GLF5	100%
DASH 8/Q200	100%
SW4	100%
B190	100%
C207	100%
PA31	100%
BN2	100%
C206	100%
DHC2	100%
PA32	100%
G44	100%
DC6	100%
C172	100%
PA18	100%
C130	100%
HH60	100%
HH65	100%

Source: Mestre Greve Associates (2009)

The data used for this analysis includes standard INM aircraft weight data based upon the average aircraft departure weights for given distances from ADQ to scheduled destinations. The assumed distance from Kodiak Airport is 0-500 nautical miles (nm) for Stage 1 in accordance with INM guidelines. Note that there were no Commercial flights of distances further than 500 nm.

The INM includes different departure profiles based upon the departure procedures being used. The primary differences between these departure profiles are aircraft engine thrust settings, flap configurations, airspeed, and climb gradient. Radar data were examined to determine which of the departure profiles available in the INM best represent actual departure operations at ADQ. Based upon this analysis the "Standard" INM departure profile was used for all aircraft for the development of the INM contours.

4.6 BASELINE 2007 DNL CONTOURS

Baseline 2007 contours for Kodiak Airport were prepared using INM Version 7.0a and are shown in Figure 4-3 for the 60, 65 and 70 DNL levels. The 60-65 DNL contains acres, the 65-70 DNL contains acres, and the 70 and greater DNL contains acres. Table 4-9 below describes the size of the respective DNL contours.

Table 4-9 Baseline 2007 DNL Area in Acres

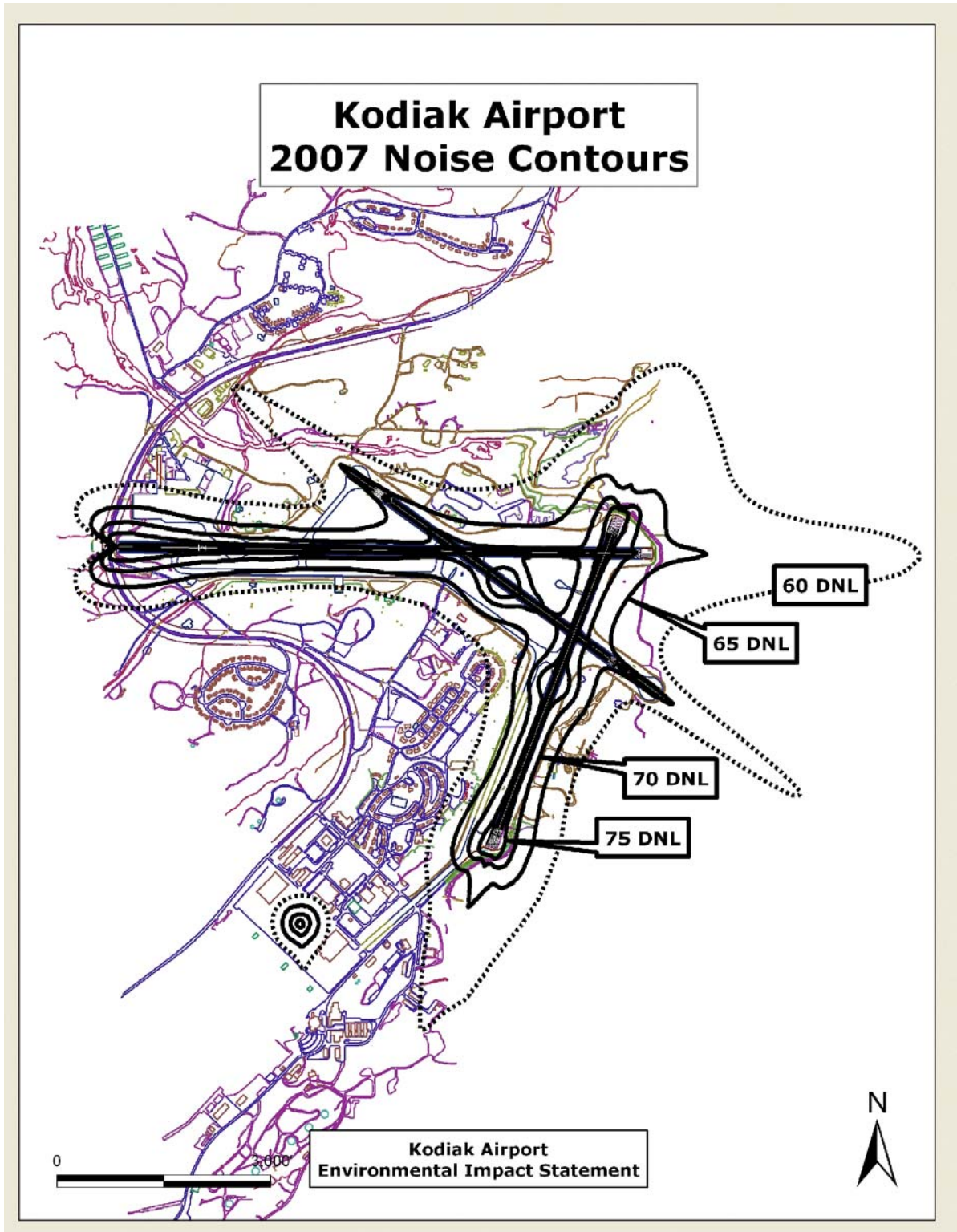
CONTOUR DNL	TOTAL ACRES
60 – 65	450
65 – 70	169
70 – 75	84
75 +	40
60 DNL & greater	743

Source: Mestre Greve Associates (2009)

Baseline 2007 noise contours are shown in Figure 4-3. The contours shown are the 60, 65, 70 and 75 DNL. The largest contour is the 60 DNL contour and the smallest contour is the 75 DNL. The runway utilization and operational flow are clearly depicted in the shape of the noise contours. Noise contours northeast of the airport are primarily influenced by departures from Runways 7 and 36, and arrivals to Runways 25 and 18.

Noise contours south of the airport are primarily influenced by arrivals to Runway 36 and departures from Runway 18. The small “island” of noise contours south of the airport is associated with USCG helicopter operations at the helipads near the USCG facilities.

Figure 4-3 Baseline 2007 DNL Contours



Source: Mestre Greve Associates (2009)

4.7 RECEPTOR LOCATIONS

Noise modeling results can be expressed in tabular format in terms of DNL at specific representative locations. INM Version 7.0a was used to determine the noise levels at receptor locations in the environs of Kodiak Airport. A list of these locations is presented in Table 4-10 and graphically depicted in Figure 4-4. These receptor locations include noise sensitive areas such as the Buskin River, USCG residential areas, and the USCG hospital. The modeled noise levels at the receptor locations for Baseline 2007 are shown in Table 4-11.

Table 4-10 Noise Receptor Locations

Location	Name	Land Use	Latitude	Longitude
1	Buskin River North	Recreational	57.758001	-152.481000
2	Buskin River Middle	Recreational	57.756001	-152.484999
3	Buskin River South	Recreational	57.754000	-152.488999
4	Base North	Residential	57.747000	-152.491000
5	Base Middle	Residential	57.742854	-152.494601
6	Base South	Residential	57.741999	-152.496001
7	USCG Hospital	Hospital	57.742001	-152.503000

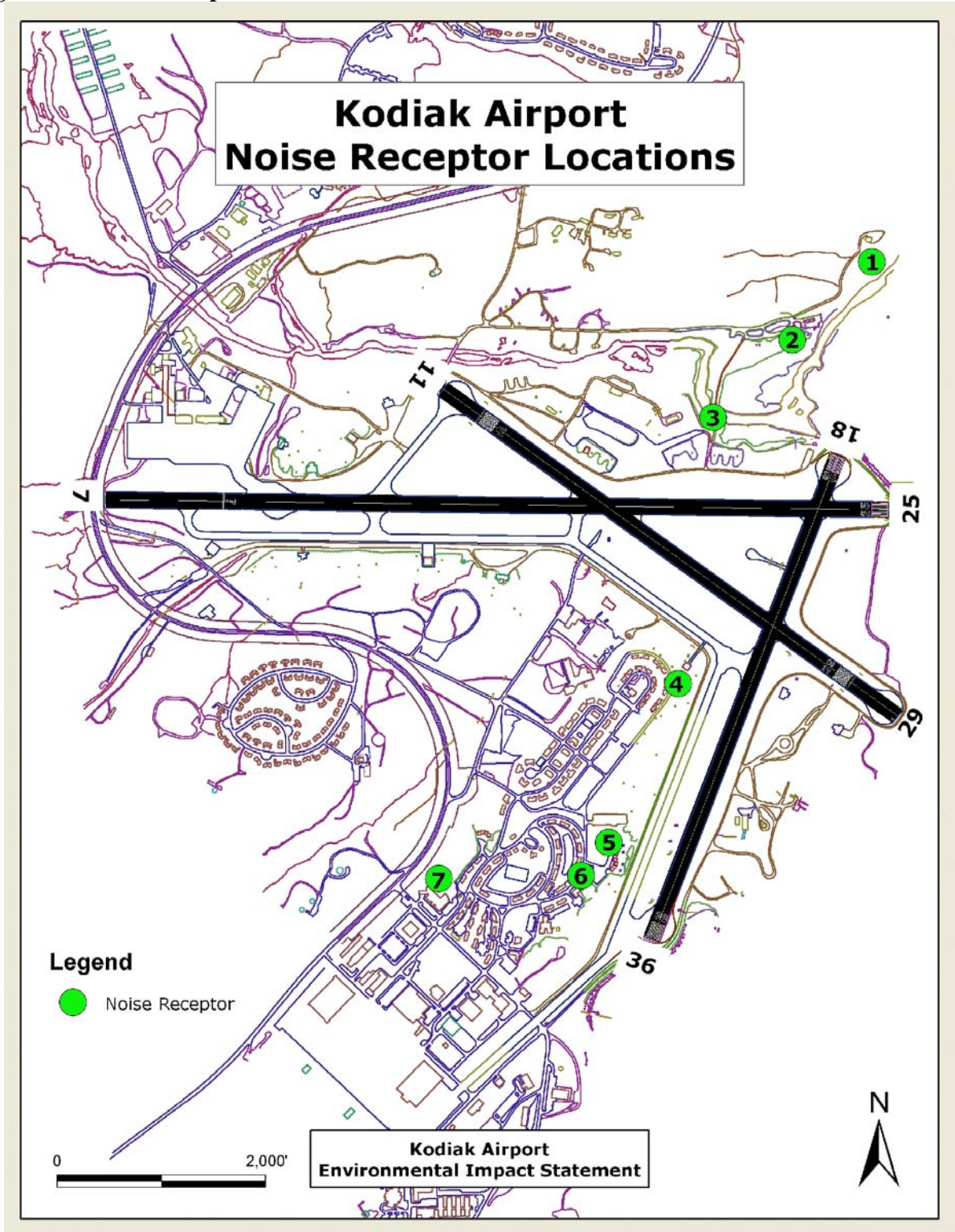
Source: Mestre Greve Associates (2009)

Table 4-11 Noise Receptor Noise Levels – Baseline 2007

Location	Name	Land Use	2007 DNL
1	Buskin River North	Recreational	60.3
2	Buskin River Middle	Recreational	60.8
3	Buskin River South	Recreational	61.1
4	Base North	Residential	63.6
5	Base Middle	Residential	60.8
6	Base South	Residential	59.8
7	USCG Hospital	Hospital	50.9

Source: Mestre Greve Associates (2009)

Figure 4-4 Noise Receptor Locations



Source: Mestre Greve Associates (2009)

5.0 FUTURE CONDITIONS WITH PROJECT ALTERNATIVES

5.1 INTRODUCTION

This section documents the analysis of aviation related noise exposure for the 6 alternatives including the no-build alternative for ADQ's Runway Safety Area (RSA) project.

The project alternatives add RSA's to runways 7/25 and 18/36. In most alternatives, runway lengths increased and displaced thresholds were created. This changed the location of the aircraft arrival touch-down point and the location of the beginning of take-off roll relative to the existing runway conditions.

Years 2014 and 2024 were selected as the forecast years to analyze future impact at ADQ. Noise contours for each alternative were calculated for each forecast year.

5.2 FUTURE OPERATIONS AND FLEET MIX

The number of future operations and aircraft types required to meet future aviation demand at ADQ were determined by analysis of historical aviation demand, projected future demand, and existing national trends such as airline purchases and options on future aircraft and the planned retirement of existing aircraft. The FAA Terminal Area Forecast (TAF) issued on December 2008 contains aviation demand forecast in terms of annual enplanements and aircraft operations grouped by major aircraft categories. The TAF forecast period is based on the fiscal years to coincide with federal budgeting. The operations data presented in this section are based on calendar year. TAF data are generalized forecast data and do not include details such as the number of operations by specific aircraft types. Factors such as the existing fleet mix and aircraft load factors specific to ADQ were used to tailor the generalized TAF data into detailed operations data for input into the Integrated Noise Model.

Based upon the TAF air carrier operations at ADQ will increase over the forecast years. However, Civil and Military Local Operations will decrease. Future operations and fleet mix data for years 2014 and 2024 are presented in Table 5-1. It is important to note that the extension of the Runway Safety Areas have no appreciable effect on the number of aircraft operations or the aircraft fleet mix.

Table 5-1 Aircraft Operations and Fleet Mix (Baseline 2007, 2014, and 2024)

Category/Aircraft	2007	2014	2024
Air Carrier	Operations	Operations	Operations
737-400	1,159	1,521	1,604
737-200	191	251	265
SUBTOTAL	1,350	1,772	1,869
General Aviation/Air Taxi/Commuter			
F28	93	87	91
CNA500	96	89	91
F50	90	84	86
C550	96	89	91
LEAR35	97	89	91
G3	90	84	86
G5	90	84	86
DASH 8/Q200	2,894	2,769	2,876
SW4	721	690	717
B190	721	690	717
C207	1,822	1,743	1,810
P31	1,822	1,743	1,810
BN2	2,734	2,616	2,716
C206	2,039	1,951	2,026
DHC2	2,039	1,951	2,026
PA32	2,729	2,611	2,711
G44	960	919	954
DC6	256	245	254
C172	299	278	283
PA18	1,493	858	872
SUBTOTAL	21,181	19,670	20,394
Military			
C130	2,594	2,421	2,421
HH60	5,249	4,909	4,909
HH65	5,249	4,909	4,909
SUBTOTAL	13,092	12,239	12,239
TOTAL OPERATIONS	35,623	33,681	34,502

* Cargo aircraft are included in the Air Carrier category

Source: FAA Terminal Area Forecast (Dec. 2008), Mestre Greve Associates (2009)

5.3 FUTURE NO PROJECT ALTERNATIVE (2014, 2024)

Future noise exposure at Kodiak Airport for the No Project Alternative is presented in this section. For the No Project Alternative, the airfield is retained in its current layout throughout the analysis period; the taxiway, runway, and flight track alignments would remain the same as existing conditions. Changes in noise exposure are due to changes in number of operations.

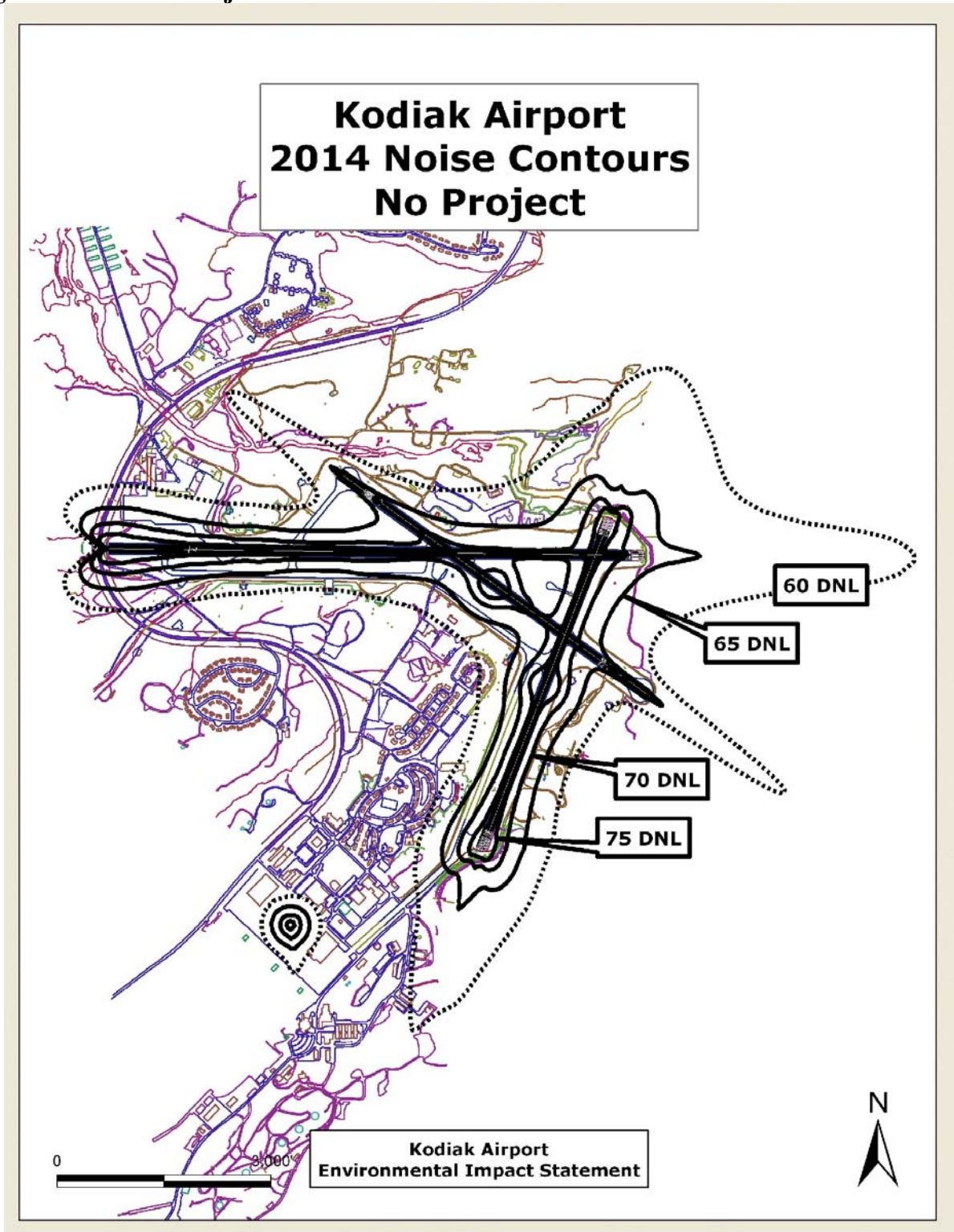
5.3.1 Future No Project Noise Modeling Assumptions

The major modeling input variables for this analysis are the number of aircraft operations, fleet mix, and runway utilization. All other INM input variables, such as time of day and stage length, are constant and are consistent with existing conditions. Flight track utilization rates for the No Project alternative were assumed to be consistent with existing conditions, using the forecast activity levels for the respective timeframes, as the No Project alternative would not change the existing runway layout and no changes to existing air traffic control procedures are proposed.

5.3.2 Future No Project DNL Noise Contours

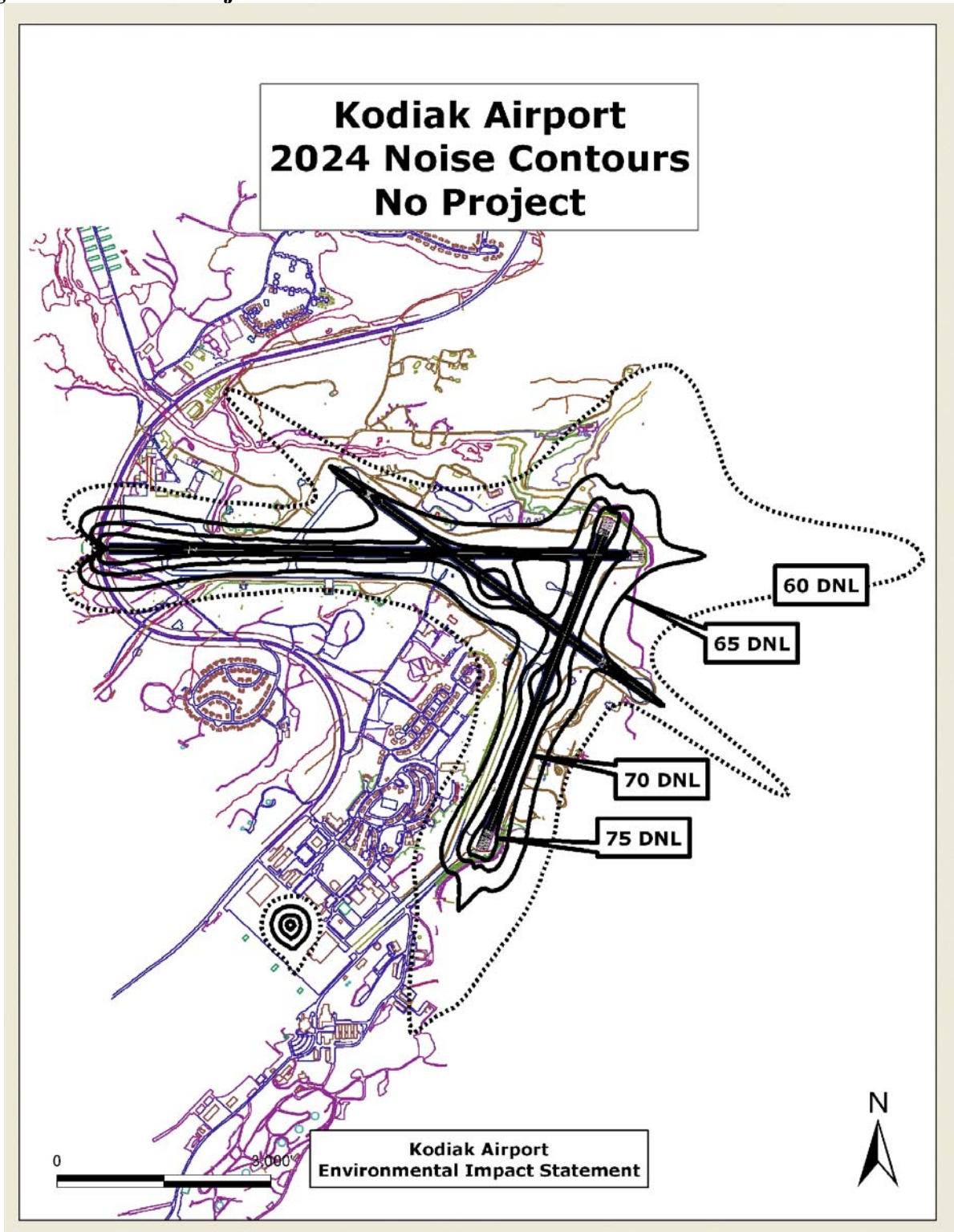
DNL contours for Kodiak Airport were prepared using the Integrated Noise Model Version 7.0a to assess noise conditions for years 2014 and 2024 for the No Project Alternative. These contours are shown in Figures 5-1 and 5-2.

Figure 5-1 2014 No Project DNL Contours



Source: Mestre Greve Associates (2009)

Figure 5-2 2024 No Project DNL Contours



Source: Mestre Greve Associates (2009)

Table 5-2 below describes the size of the respective DNL contours in acres. The contour area for existing conditions is shown for comparison.

Table 5-2 Forecast Years No Project Noise Exposure DNL Area in Acres

Contour DNL	Baseline 2007	2014	2024
		No Project	No Project
60 – 65	450	453	467
65 – 70	169	171	174
70 – 75	84	85	87
75+	40	41	42
60 & greater	743	750	770

Source: Mestre Greve Associates (2009)

As shown in Table 5-2, the 60 through 75 DNL contour would increase in the forecast years 2014 and 2024 under No Project conditions. Although the total operations for these forecast years are less than the total operations for the baseline year, the contours increased in size due to the forecast increase in Air Carrier operations.

DNL noise levels can also be expressed in tabular form. DNL noise levels for the receptor locations for Baseline 2007, 2014 and 2024 No Project alternatives are shown in Table 5-4.

Table 5-4 DNL Summary of No Project Conditions at Receptor Locations

Location	Name	Land Use	2007 DNL	2014 No Project DNL	2024 No Project DNL
1	Buskin River North	Recreational	60.3	60.3	60.4
2	Buskin River Middle	Recreational	60.8	60.9	61.0
3	Buskin River South	Recreational	61.1	61.3	61.4
4	Base North	Residential	63.6	63.4	63.4
5	Base Middle	Residential	60.8	60.9	61.0
6	Base South	Residential	59.8	60.0	60.2
7	USCG Hospital	Hospital	50.9	51.1	51.2

Source: Mestre Greve Associates (2009)

5.4 NOISE IMPACT OF RSA ALTERNATIVES

Future noise exposure at Kodiak Airport for the construction of Runway Safety Areas is presented in this section. Analysis was conducted for years each of the 5 RSA alternatives for forecast years 2014 and 2024.

5.4.1 RSA Alternatives Modeling Assumptions

Runway use and flight track locations are a critical component of the analysis of noise exposure for these alternatives. The construction of these alternatives will not change runway utilization from the Baseline condition. Flight track allocations and aircraft fleet mix for the implementation of every alternative are identical to Baseline and No Project conditions. The RSA alternatives do change the points at which the aircraft touchdown and the point at which aircraft begin takeoff roll. Changing these aircraft flight characteristics normally change the shape and coverage area of the noise contours.

5.4.2 RSA Alternatives DNL Noise Contours

DNL contours for Kodiak Airport with RSA's were prepared using the Integrated Noise Model Version 7.0a for years 2014 and 2024. These contours are shown in Figures 5-3 and 5-12.

Figure 5-3 RW 7/25 Alternative 2 – Year 2014 DNL Noise Contours

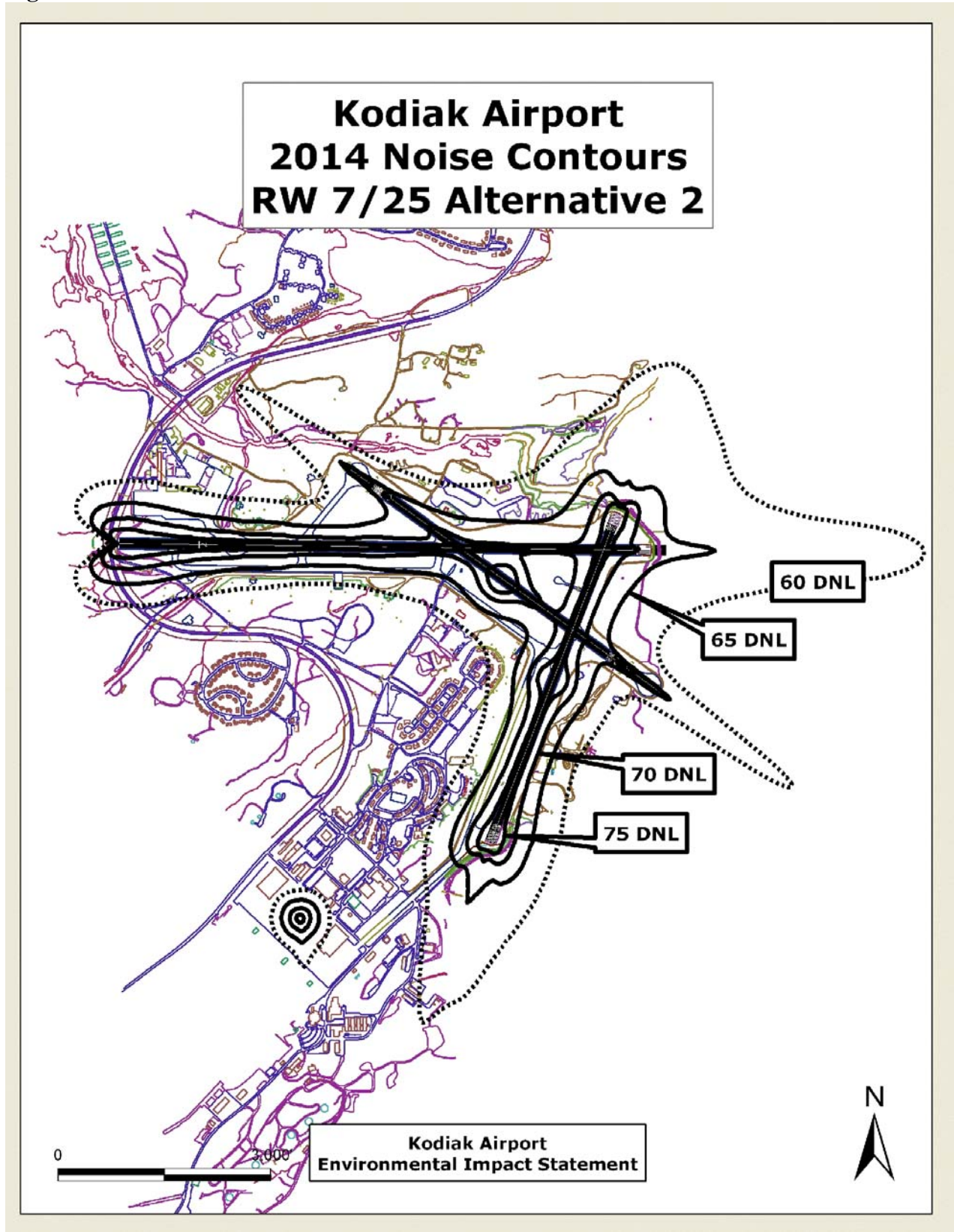
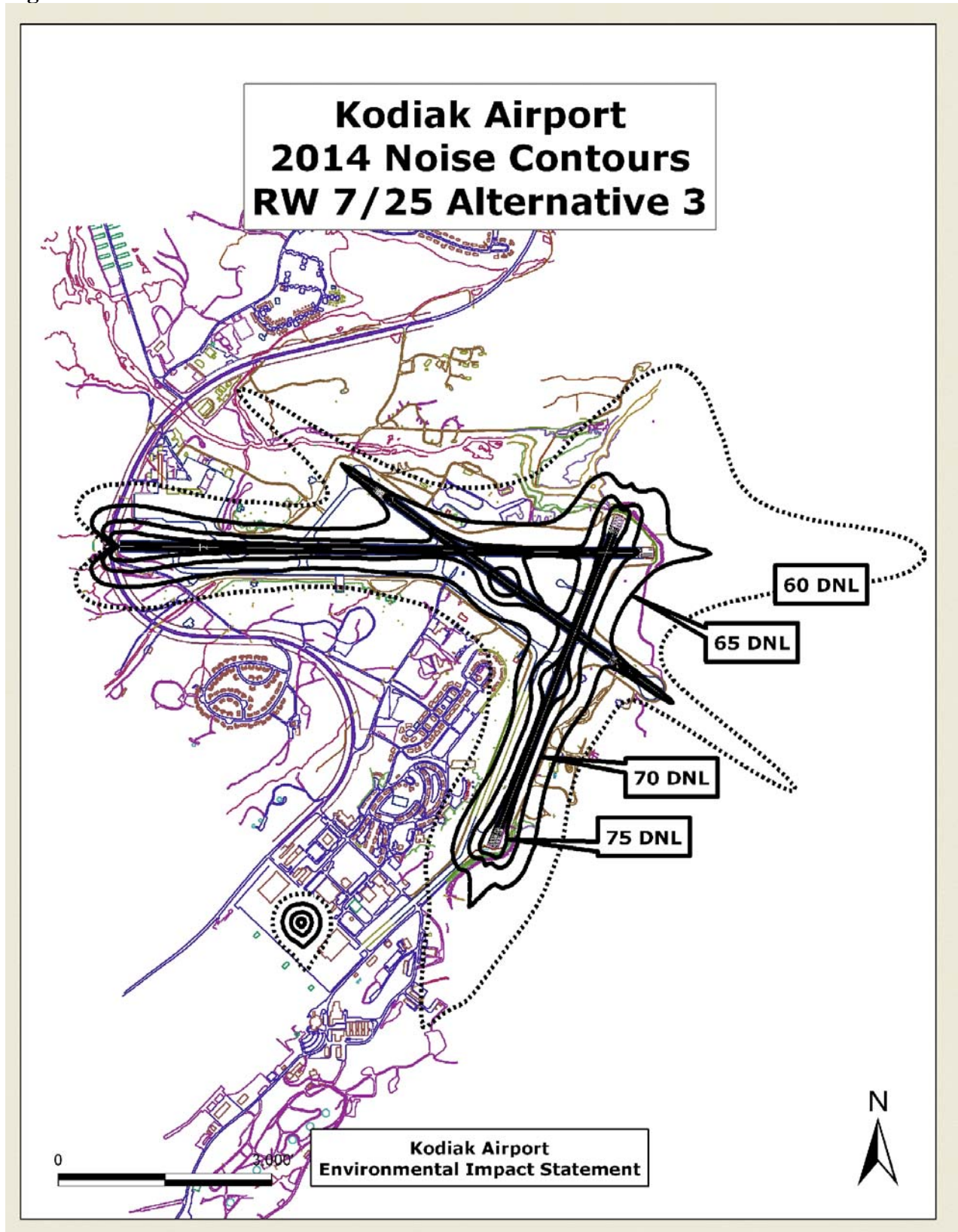
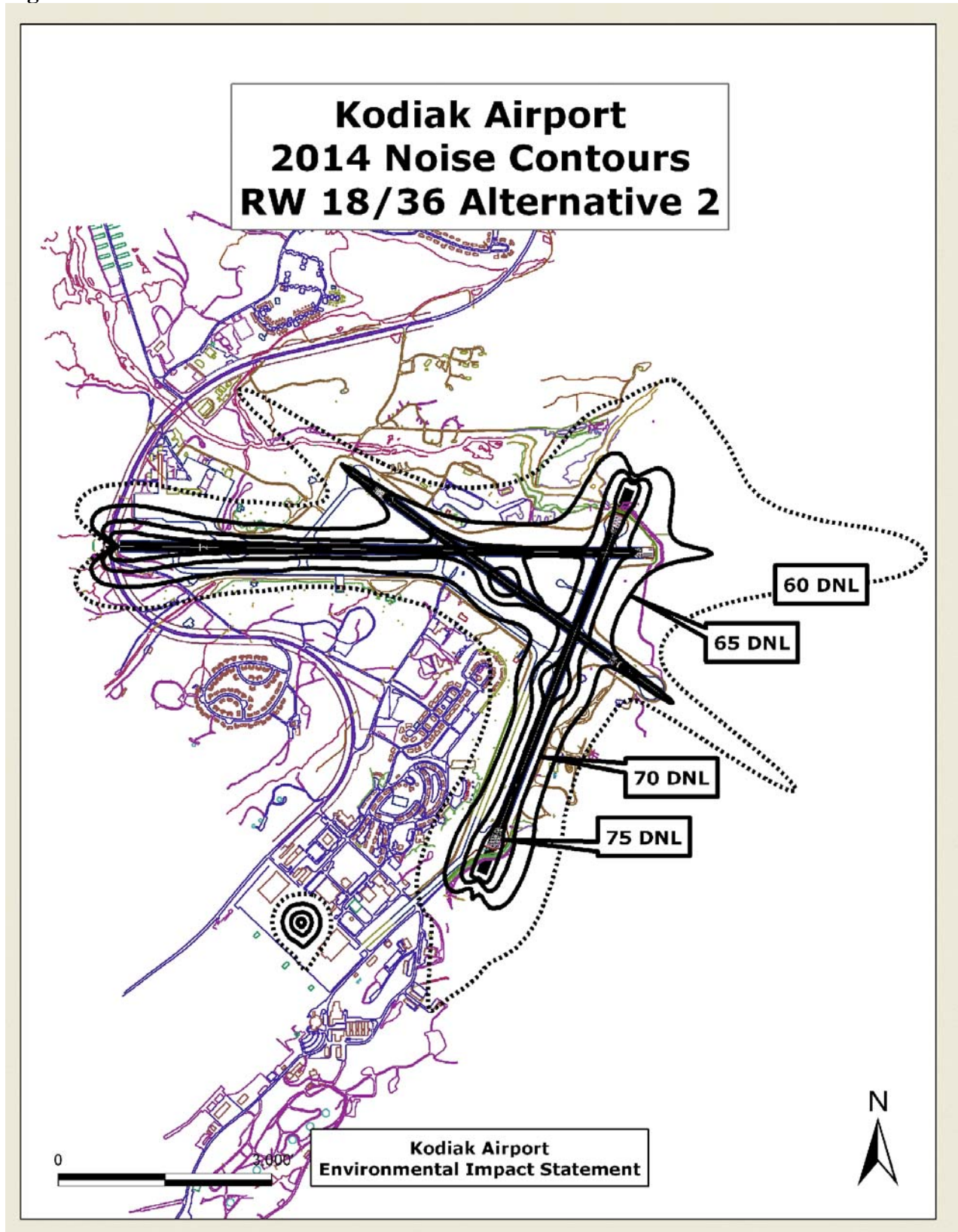


Figure 5-4 RW 7/25 Alternative 3 – Year 2014 DNL Noise Contours



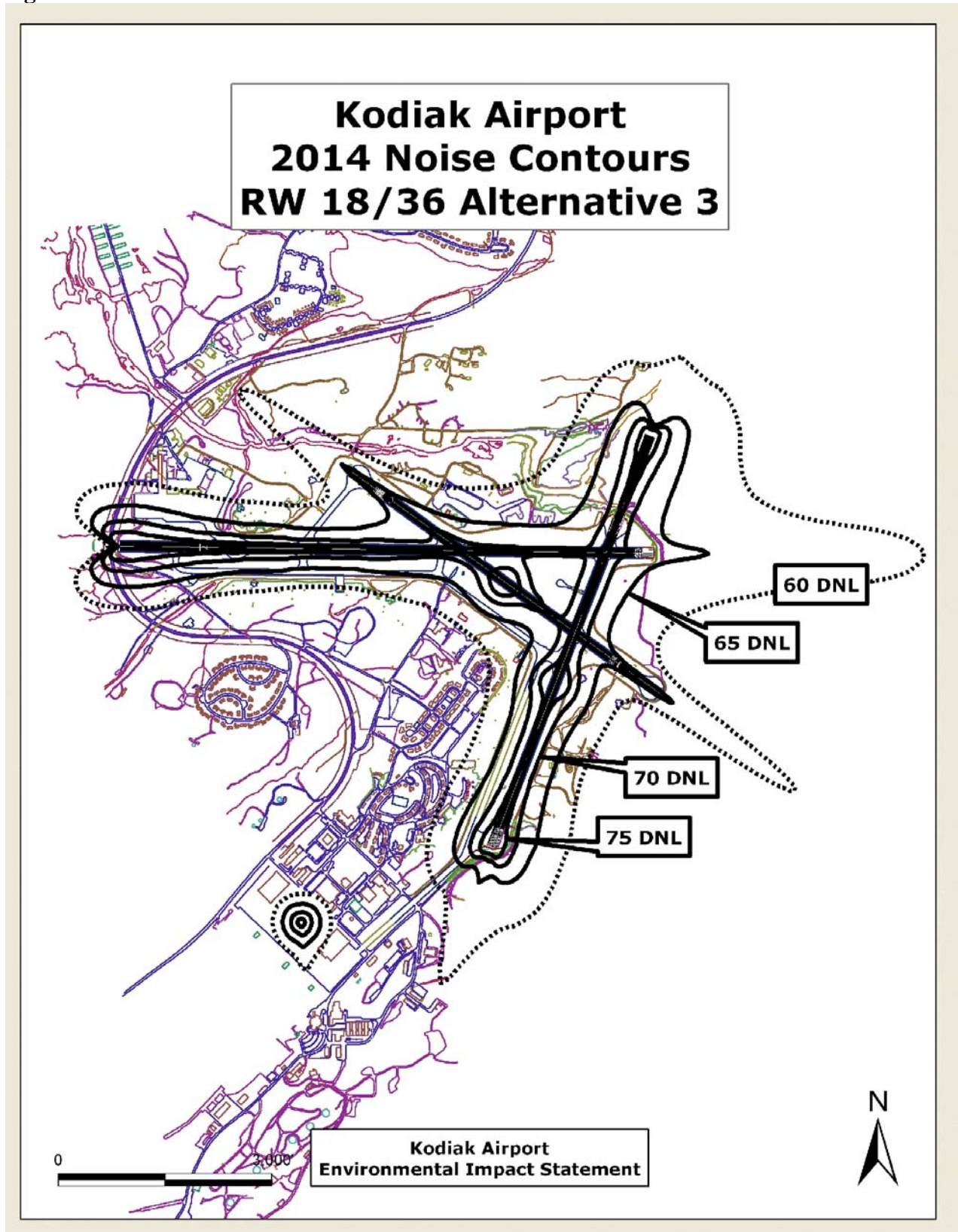
Source: Mestre Greve Associates (2009)

Figure 5-5 RW 18/36 Alternative 2 – Year 2014 DNL Noise Contours



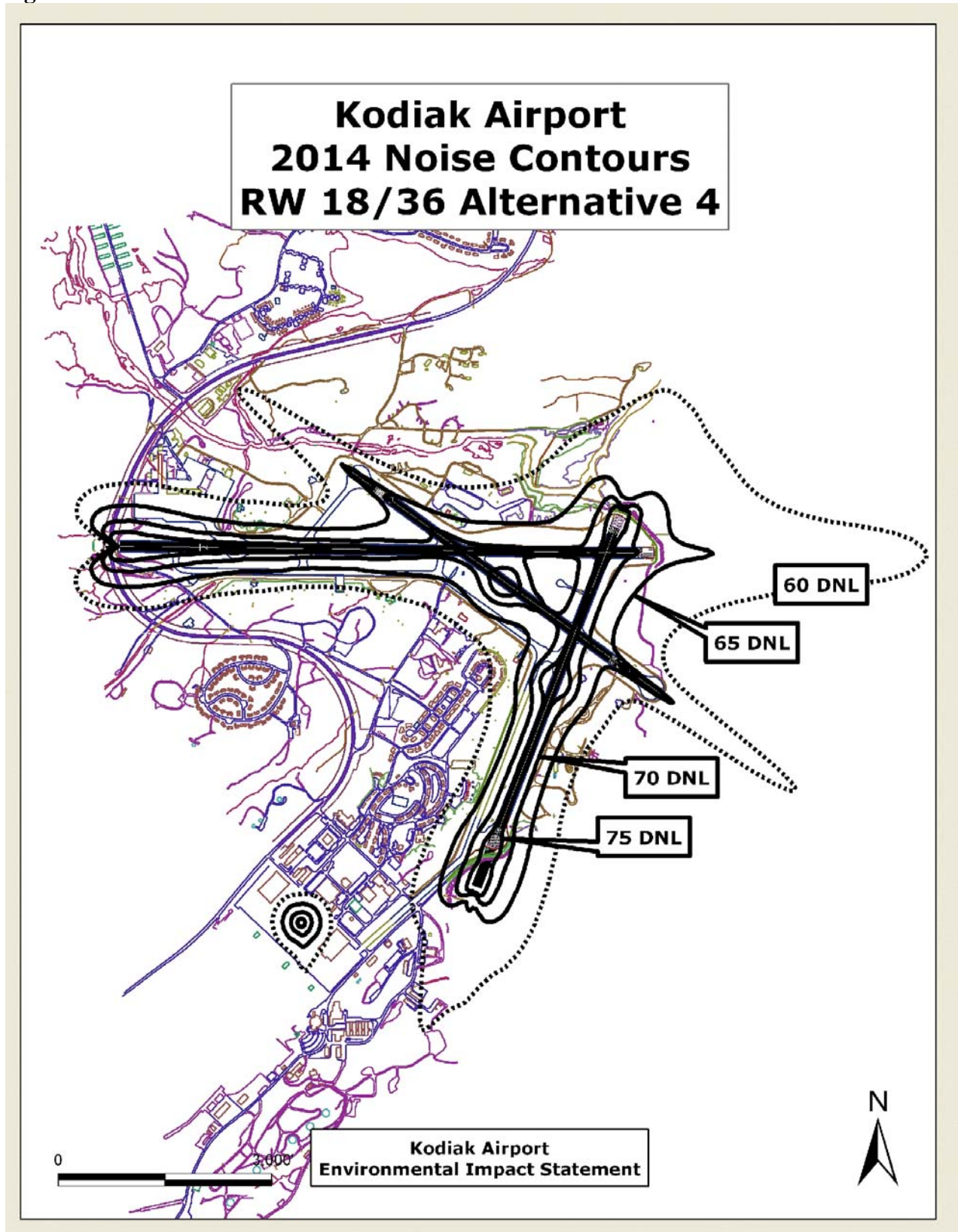
Source: Mestre Greve Associates (2009)

Figure 5-6 RW 18/36 Alternative 3 – Year 2014 DNL Noise Contours



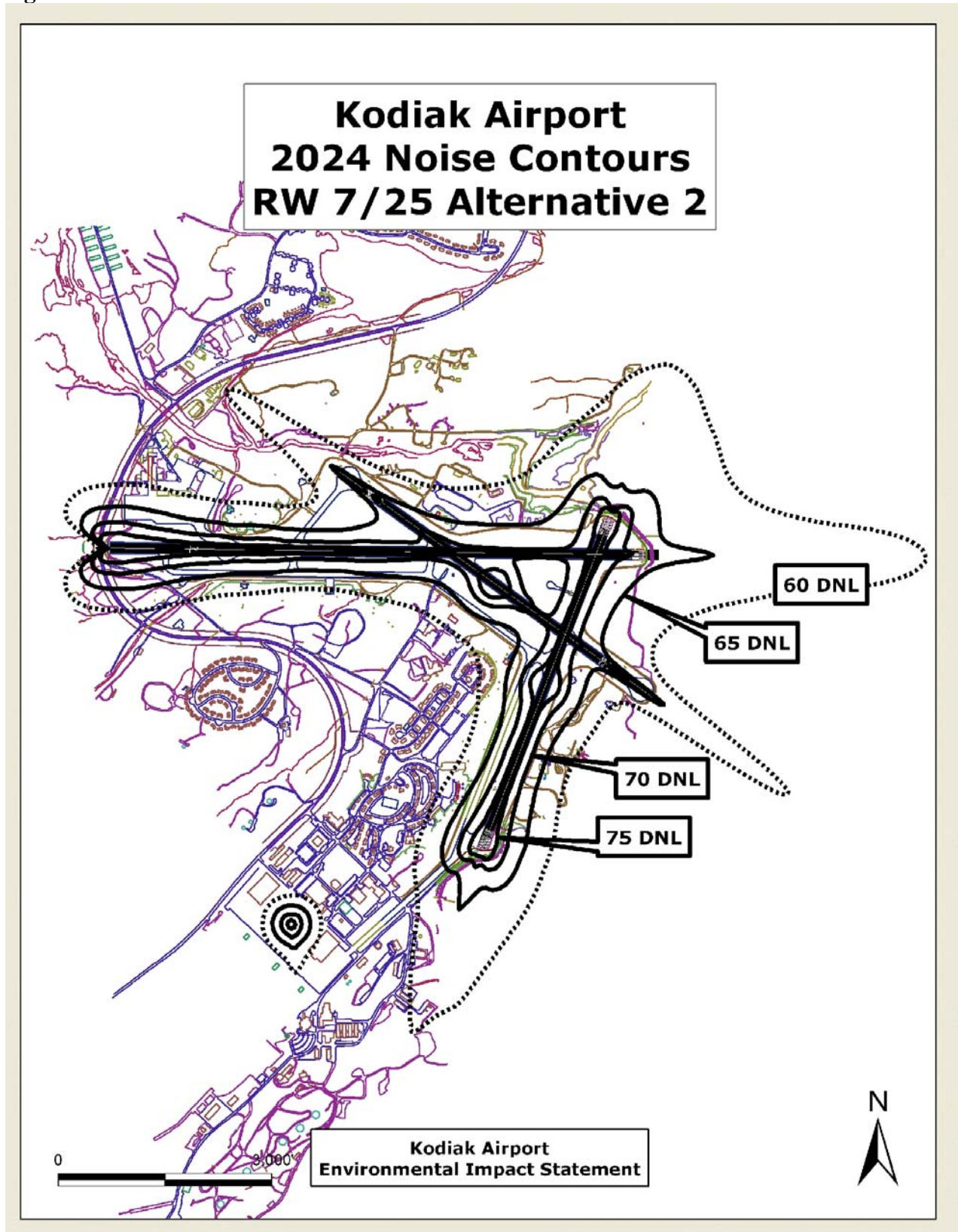
Source: Mestre Greve Associates (2009)

Figure 5-7 RW 18/36 Alternative 4 – Year 2014 DNL Noise Contours



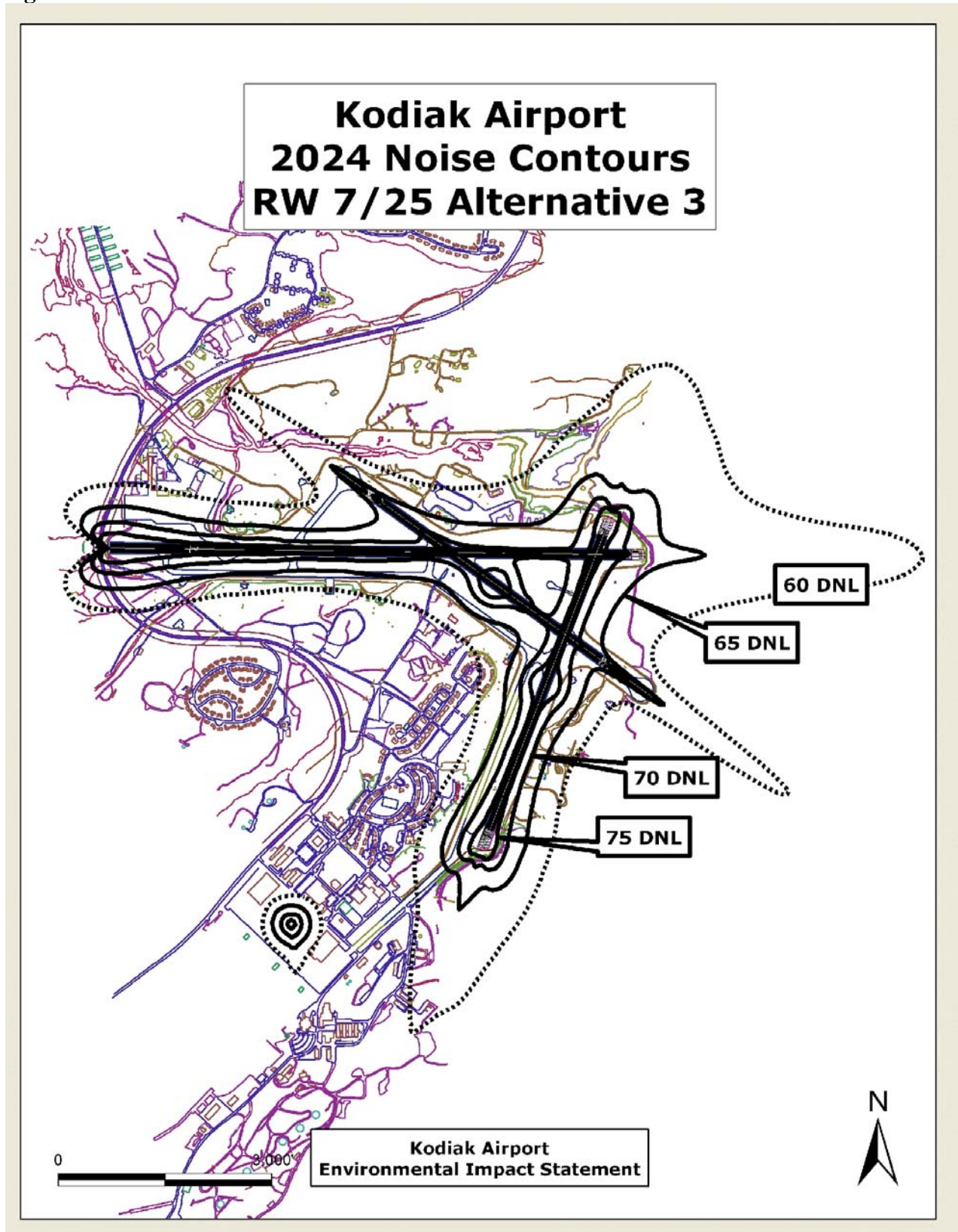
Source: Mestre Greve Associates (2009)

Figure 5-8 RW 7/25 Alternative 2 – Year 2024 DNL Noise Contours



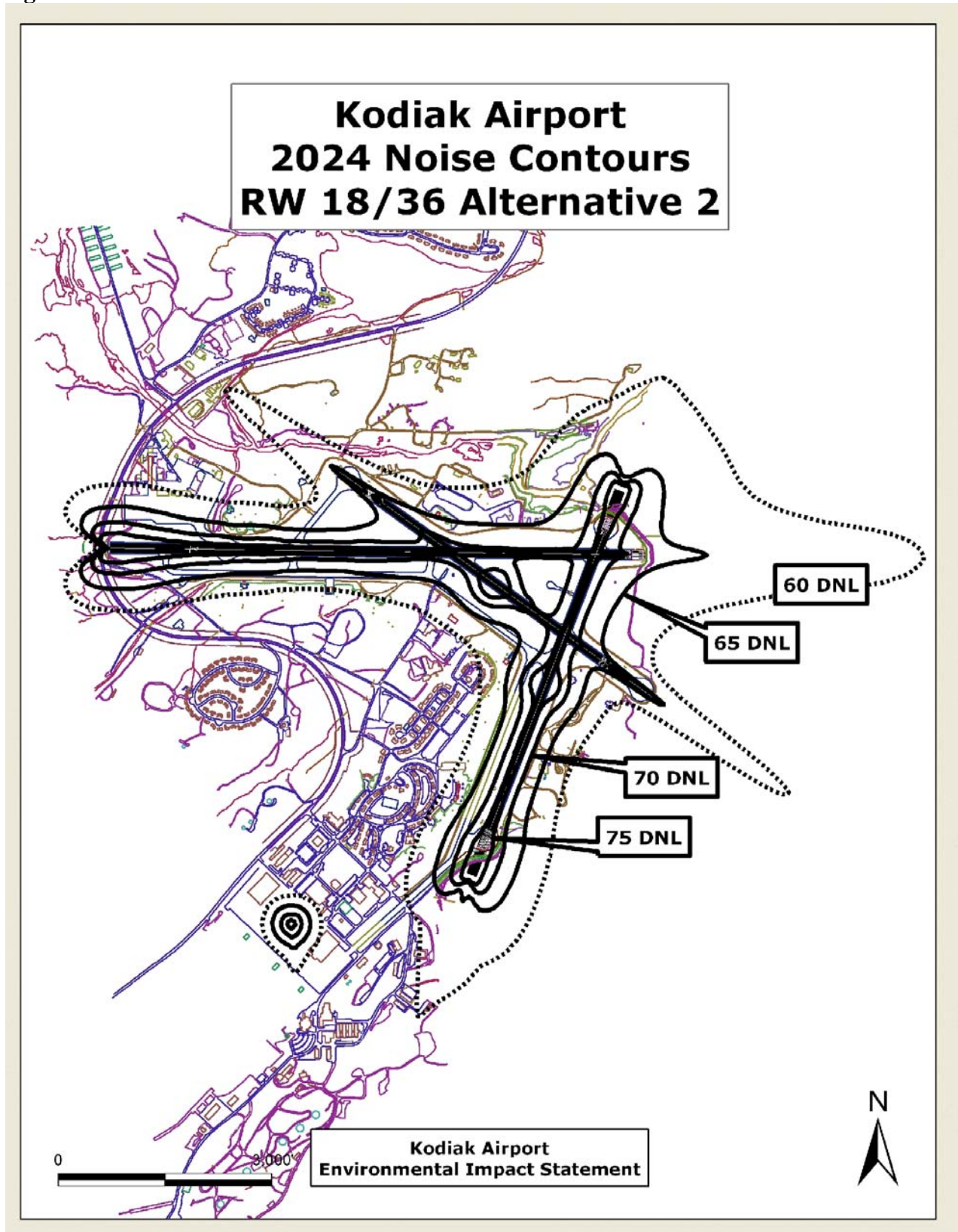
Source: Mestre Greve Associates (2009)

Figure 5-9 RW 7/25 Alternative 3 – Year 2024 DNL Noise Contours



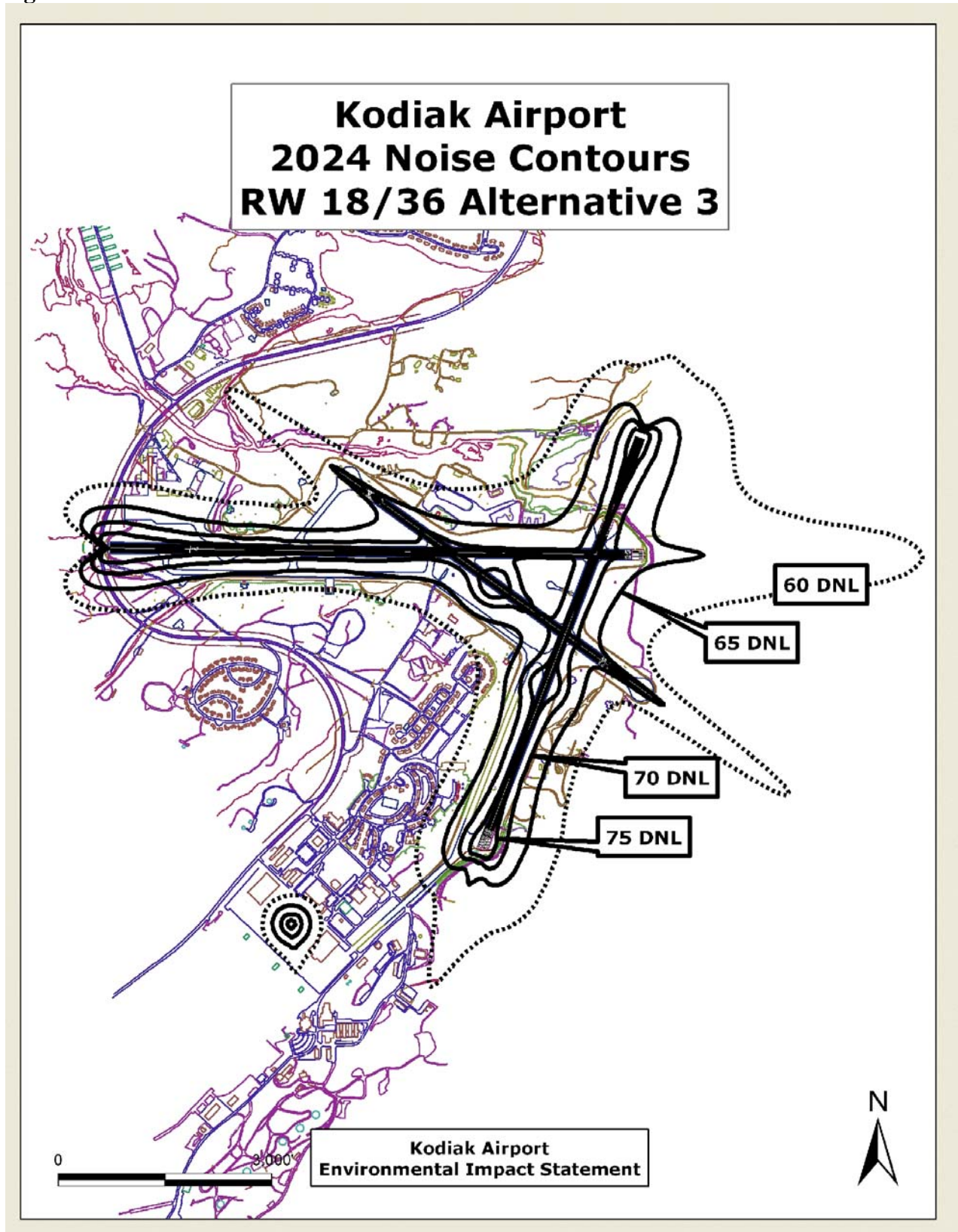
Source: Mestre Greve Associates (2009)

Figure 5-10 RW 18/36 Alternative 2 – Year 2024 DNL Noise Contours



Source: Mestre Greve Associates (2009)

Figure 5-11 RW 18/36 Alternative 3 – Year 2024 DNL Noise Contours



Source: Mestre Greve Associates (2009)

Figure 5-12 RW 18/36 Alternative 4 – Year 2024 DNL Noise Contours

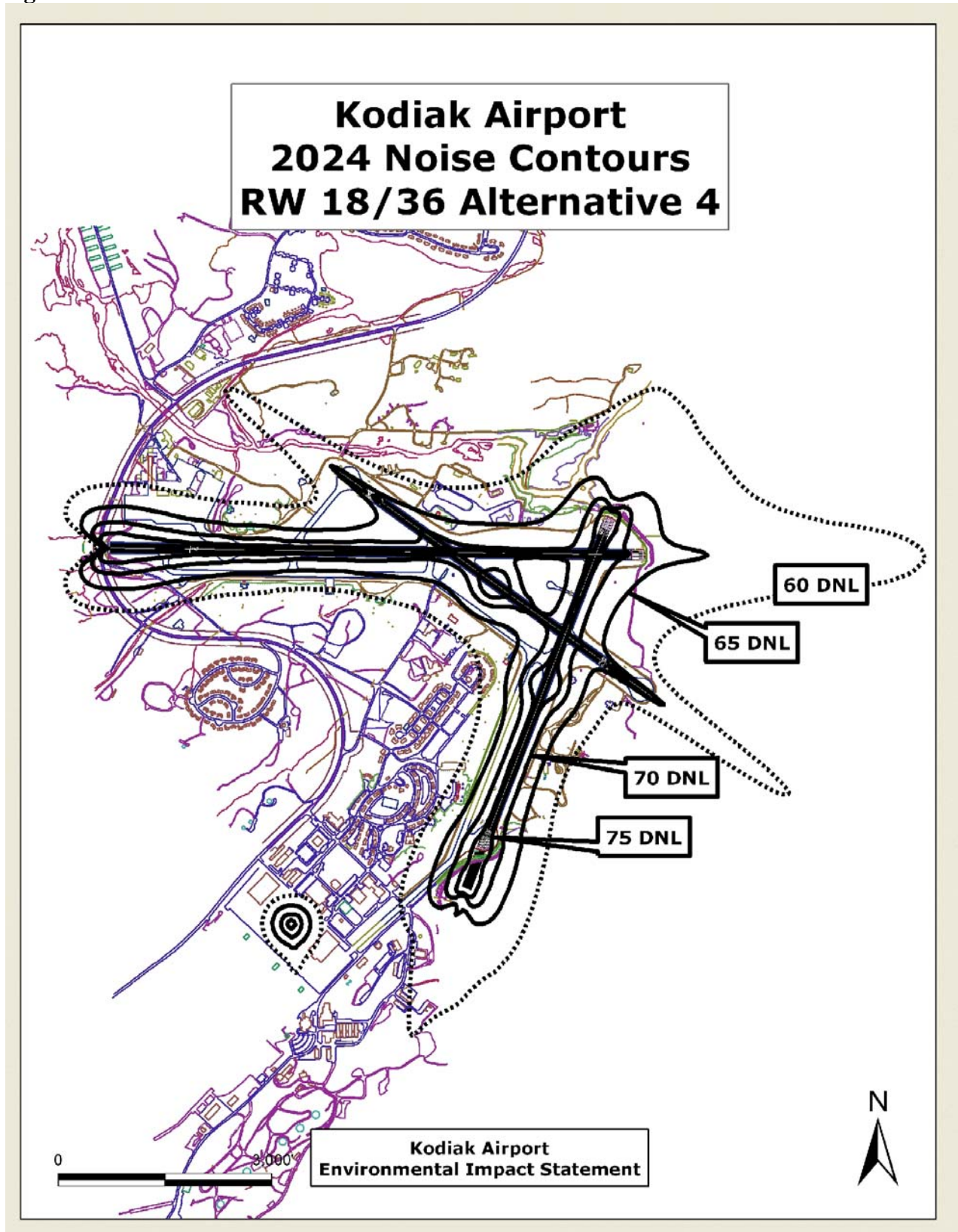


Table 5-5 below describes the size of the respective 2014 DNL contours. The contour area for the 2014 No Project alternative is shown for comparison.

Table 5-5 Year 2014 RSA Alternatives Noise Exposure DNL Area in Acres

Contour DNL	2014 No Project	2014 RW 7/25 Alternative 2	2014 RW 7/25 Alternative 3	2014 RW 18/36 Alternative 2	2014 RW 18/36 Alternative 3	2014 RW 18/36 Alternative 4
60 – 65	453	453	453	438	434	444
65 – 70	171	171	171	178	186	174
70 – 75	85	85	85	90	92	89
75+	41	41	41	40	38	40
60+	750	750	750	746	750	747

Source: Mestre Greve Associates (2009)

As shown in Table 5-5, the 2014 No Project Alternative, and RW 7/25 Alternatives 2 and 3 would have the same noise exposure. The 2014 RW 18/36 Alternatives 2, 3, and 4 would decrease noise exposure between 60 – 65 and 75+ DNL as the noise exposure between 65 – 70 and 70 – 75 DNL would increase.

The noise exposure for the 2024 alternatives would change similar to the 2014 noise exposure changes as shown in Table 5-6.

Table 5-6 Year 2024 RSA Alternatives Noise Exposure DNL Area in Acres

Contour DNL	2024 No Project	2024 RW 7/25 Alternative 2	2024 RW 7/25 Alternative 3	2024 RW 18/36 Alternative 2	2024 RW 18/36 Alternative 3	2024 RW 18/36 Alternative 4
60 – 65	467	467	467	452	447	458
65 – 70	174	174	174	181	189	176
70 – 75	87	87	87	92	94	91
75 +	42	42	42	41	40	42
60 +	770	770	770	766	770	767

Source: Mestre Greve Associates (2009)

The modeled noise levels at the receptor locations for 2014 and 2024 alternatives are shown below in Tables 5-7a and 5-7b. The Baseline 2007 and No Project noise levels are included as reference.

Table 5-7a DNL Summary of RSA Alternatives at Receptor Locations – 2014

Location	Name	Land Use	2007 DNL	2014 No Project DNL	2014 RW 7/25 Alt 2 DNL	2014 RW 7/25 Alt 3 DNL	2014 RW 18/36 Alt 2 DNL	2014 RW 18/36 Alt 3 DNL	2014 RW 18/36 Alt 4 DNL
1	Buskin River North	Recreational	60.3	60.3	60.3	60.3	59.8	61.3	59.5
2	Buskin River Middle	Recreational	60.8	60.9	60.9	60.9	61.6	62.2	60.6
3	Buskin River South	Recreational	61.1	61.3	61.3	61.3	61.4	61.1	61.5
4	Base North	Residential	63.6	63.4	63.4	63.4	63.3	63.4	63.3
5	Base Middle	Residential	60.8	60.9	60.9	60.9	60.5	61.5	60.1
6	Base South	Residential	59.8	60.0	60.0	60.0	59.8	60.5	59.3
7	USCG Hospital	Hospital	50.9	51.1	51.1	51.1	51.3	51.6	51.1

Source: Mestre Greve Associates (2009)

Table 5-7b DNL Summary of RSA Alternatives at Receptor Locations – 2024

Location	Name	Land Use	2007 DNL	2024 No Project DNL	2024 RW 7/25 Alt 2 DNL	2024 RW 7/25 Alt 3 DNL	2024 RW 18/36 Alt 2 DNL	2024 RW 18/36 Alt 3 DNL	2024 RW 18/36 Alt 4 DNL
1	Buskin River North	Recreational	60.3	60.4	60.4	60.4	59.9	61.4	59.6
2	Buskin River Middle	Recreational	60.8	61.0	61.0	61.0	61.7	62.4	60.8
3	Buskin River South	Recreational	61.1	61.4	61.4	61.4	61.5	61.2	61.6
4	Base North	Residential	63.6	63.4	63.4	63.4	63.4	63.5	63.4
5	Base Middle	Residential	60.8	61.0	61.0	61.0	60.6	61.6	60.2
6	Base South	Residential	59.8	60.2	60.2	60.2	60.0	60.6	59.4
7	USCG Hospital	Hospital	50.9	51.2	51.2	51.2	51.4	51.7	51.2

Source: Mestre Greve Associates (2009)

In consideration of contour and receptor location modeling accuracy, the future noise levels and contours for 2014 and 2024 are essentially identical, in terms of real recognizable change, to the Baseline 2007 conditions. Although slight changes in noise levels are discernable with computer analysis, the small magnitude of these differences indicates that the noise environment for the analysis period is predicted to be very stable. Tables 5-8a and b detail the change in noise level at each of the 7 sensitive receptor locations for the years 2014 and 2024 relative to the year 2007. Tables 5-9a and b detail the change in noise level at each of the 7 sensitive receptor locations for the years 2014 and 2024 relative to the no project case for each year respectively. Note that in all cases the noise exposure at the sensitive receptors for future conditions with or without the project are less than 65 DNL.

Table 5-8a Change of DNL from 2007 to 2014 Project Alternatives at Receptor Locations

Location	Name	Land Use	2014 No Project DNL change	2014 RW 7/25 Alt 2 DNL change	2014 RW 7/25 Alt 3 DNL change	2014 RW 18/36 Alt 2 DNL change	2014 RW 18/36 Alt 3 DNL change	2014 RW 18/36 Alt 4 DNL change
1	Buskin River North	Recreational	0	0	0	-0.5	1	-0.8
2	Buskin River Middle	Recreational	0.1	0.1	0.1	0.8	1.4	-0.2
3	Buskin River South	Recreational	0.2	0.2	0.2	0.3	0	0.4
4	Base North	Residential	-0.2	-0.2	-0.2	-0.3	-0.2	-0.3
5	Base Middle	Residential	0.1	0.1	0.1	-0.3	0.7	-0.7
6	Base South	Residential	0.2	0.2	0.2	0	0.7	-0.5
7	USCG Hospital	Hospital	0.2	0.2	0.2	0.4	0.7	0.2

Source: Mestre Greve Associates (2009)

Table 5-8b Change of DNL from 2007 to 2024 Project Alternatives at Receptor Locations

Location	Name	Land Use	2024 No Project DNL change	2024 RW 7/25 Alt 2 DNL change	2024 RW 7/25 Alt 3 DNL change	2024 RW 18/36 Alt 2 DNL change	2024 RW 18/36 Alt 3 DNL change	2024 RW 18/36 Alt 4 DNL change
1	Buskin River North	Recreational	0.1	0.1	0.1	-0.4	1.1	-0.7
2	Buskin River Middle	Recreational	0.2	0.2	0.2	0.9	1.6	0
3	Buskin River South	Recreational	0.3	0.3	0.3	0.4	0.1	0.5
4	Base North	Residential	-0.2	-0.2	-0.2	-0.2	-0.1	-0.2
5	Base Middle	Residential	0.2	0.2	0.2	-0.2	0.8	-0.6
6	Base South	Residential	0.4	0.4	0.4	0.2	0.8	-0.4
7	USCG Hospital	Hospital	0.3	0.3	0.3	0.5	0.8	0.3

Source: Mestre Greve Associates (2009)

Table 5-8c Change of DNL from 2014 No Project to 2014 Project Alternatives at Receptor Locations

Location	Name	Land Use	2014 RW 7/25 Alt 2 DNL change	2014 RW 7/25 Alt 3 DNL change	2014 RW 18/36 Alt 2 DNL change	2014 RW 18/36 Alt 3 DNL change	2014 RW 18/36 Alt 4 DNL change
1	Buskin River North	Recreational	0	0	-0.5	1	-0.8
2	Buskin River Middle	Recreational	0	0	0.7	1.3	-0.3
3	Buskin River South	Recreational	0	0	0.1	-0.2	0.2
4	Base North	Residential	0	0	-0.1	0	-0.1
5	Base Middle	Residential	0	0	-0.4	0.6	-0.8
6	Base South	Residential	0	0	-0.2	0.5	-0.7
7	USCG Hospital	Hospital	0	0	0.2	0.5	0

Source: Mestre Greve Associates (2009)

Table 5-8d Change of DNL from 2024 No Project to 2024 Project Alternatives at Receptor Locations

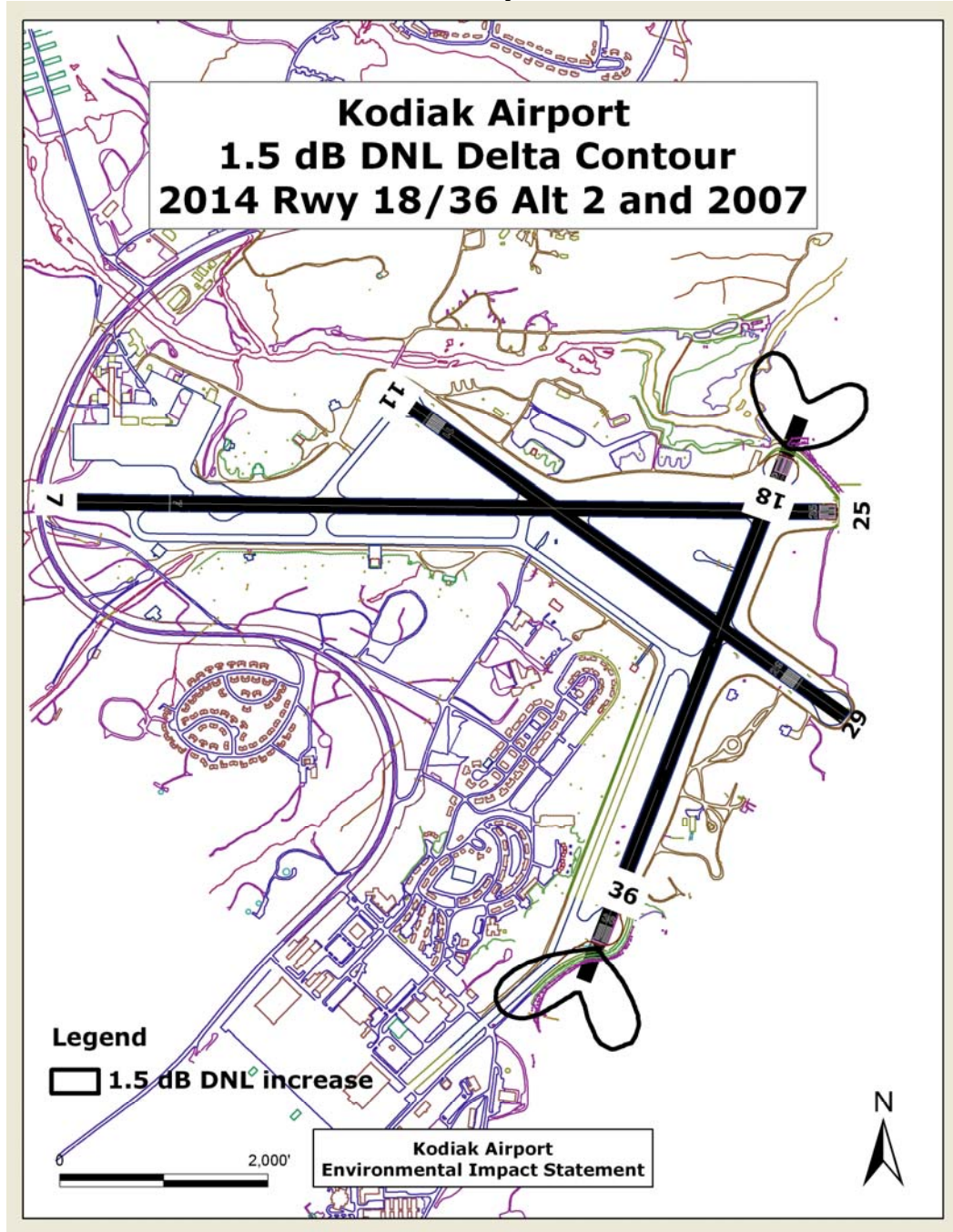
Location	Name	Land Use	2024 RW 7/25 Alt 2 DNL change	2024 RW 7/25 Alt 3 DNL change	2024 RW 18/36 Alt 2 DNL change	2024 RW 18/36 Alt 3 DNL change	2024 RW 18/36 Alt 4 DNL change
1	Buskin River North	Recreational	0	0	-0.5	1.0	-0.8
2	Buskin River Middle	Recreational	0	0	0.7	1.4	-0.2
3	Buskin River South	Recreational	0	0	0.1	-0.2	0.2
4	Base North	Residential	0	0	0	0.1	0
5	Base Middle	Residential	0	0	-0.4	0.6	-0.8
6	Base South	Residential	0	0	-0.2	0.4	-0.8
7	USCG Hospital	Hospital	0	0	0.2	0.5	0

Source: Mestre Greve Associates (2009)

5.4.3 RSA Alternatives 1.5 dB DNL Delta Noise Contours

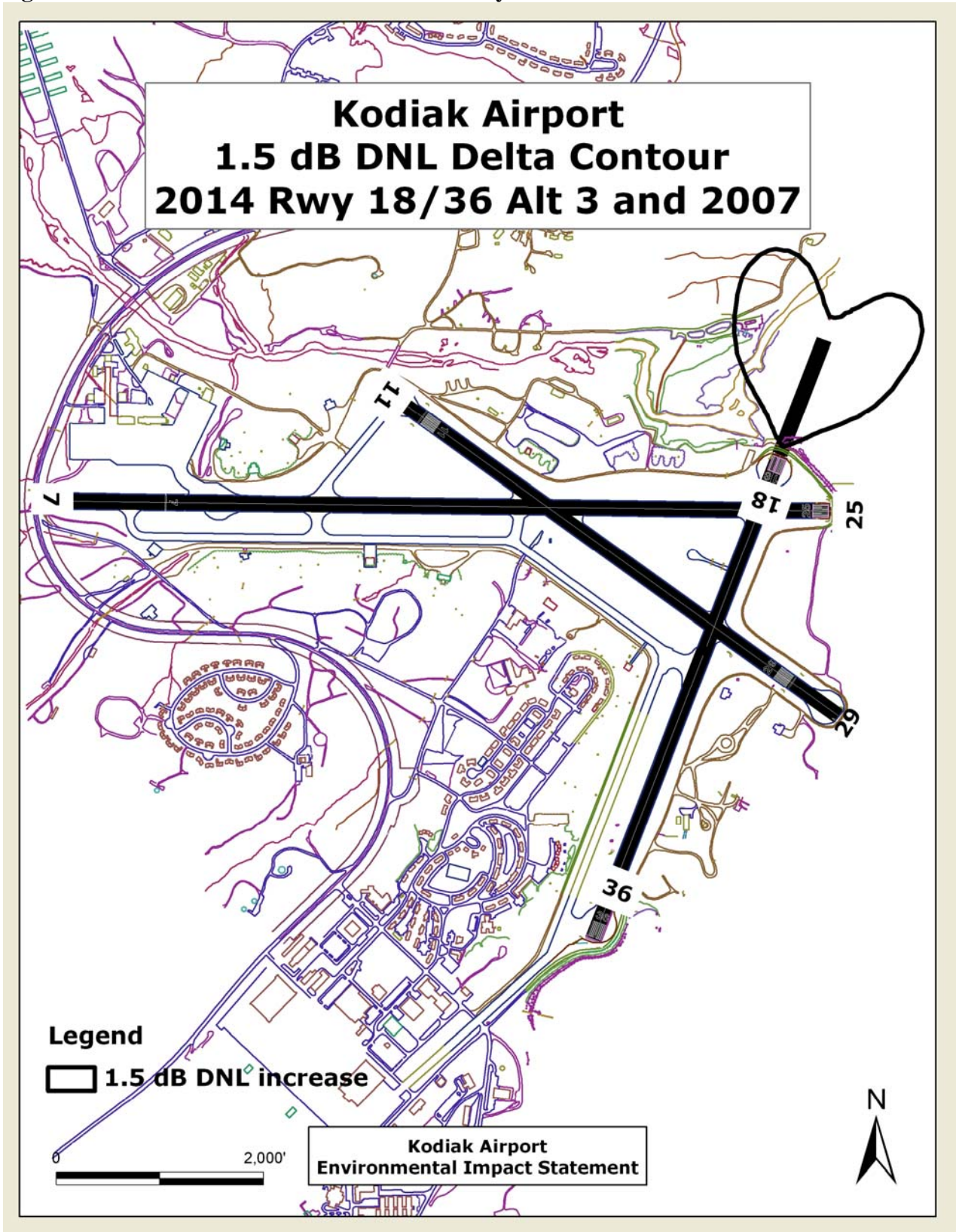
Noise contours that showed the difference between project alternatives were produced by calculating the changes in DNL between the 2007, 2014 No Project, and 2024 No Project scenarios and each alternative. The 1.5 dB increase in DNL contour (Delta Contour) for Rwy 7/25 Alternative 2 was located within the runway boundaries and for Rwy 7/25 Alternative 3 was zero. Figures 5-13 through 5-24 show the Delta Noise Contours that resulted in an increase of 1.5 dB DNL located outside of the runway boundaries.

Figure 5-13 1.5 dB DNL Delta Contour 2014 Rwy 18/36 Alternative 2 and 2007



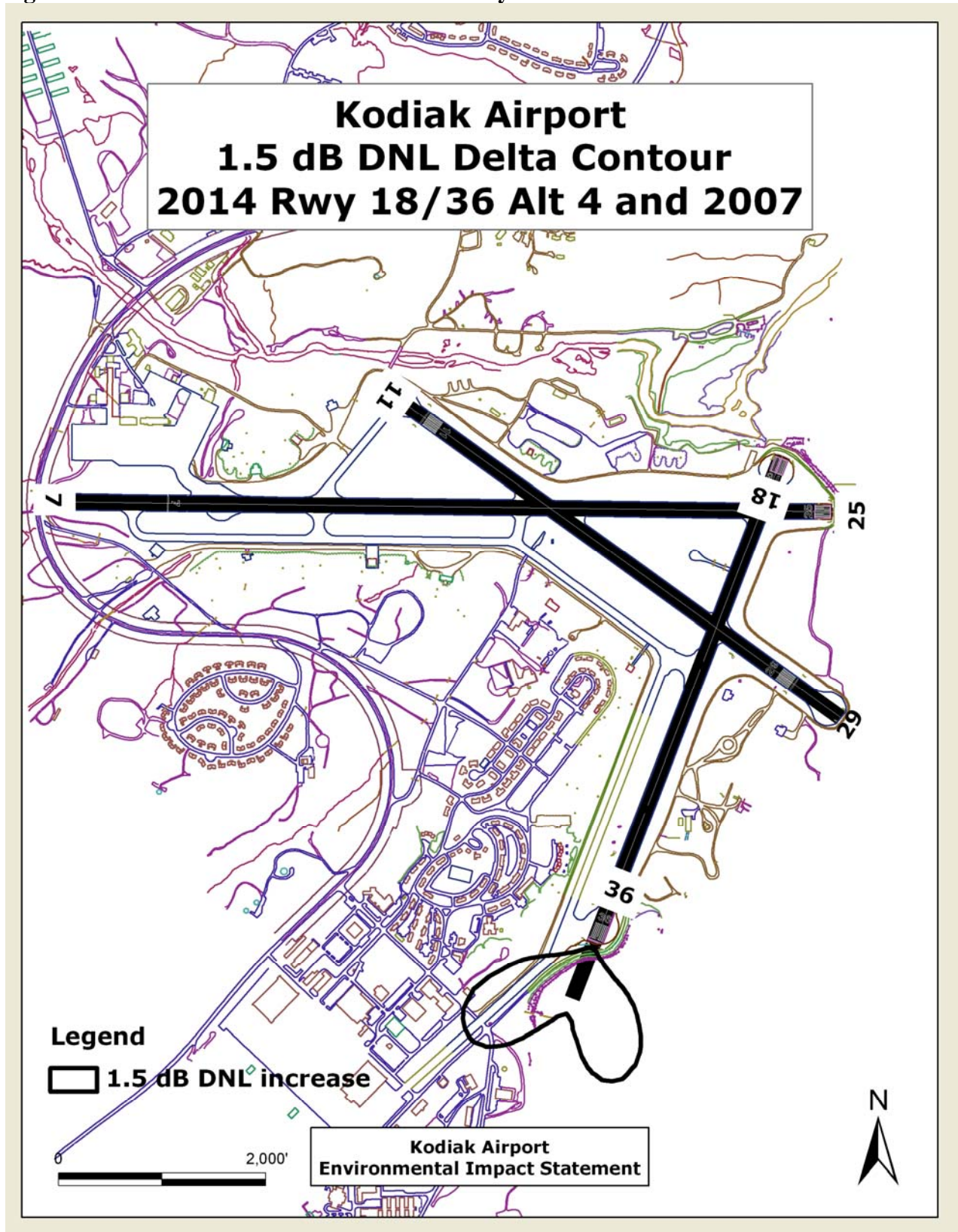
Source: Mestre Greve Associates (2009)

Figure 5-14 1.5 dB DNL Delta Contour 2014 Rwy 18/36 Alternative 3 and 2007



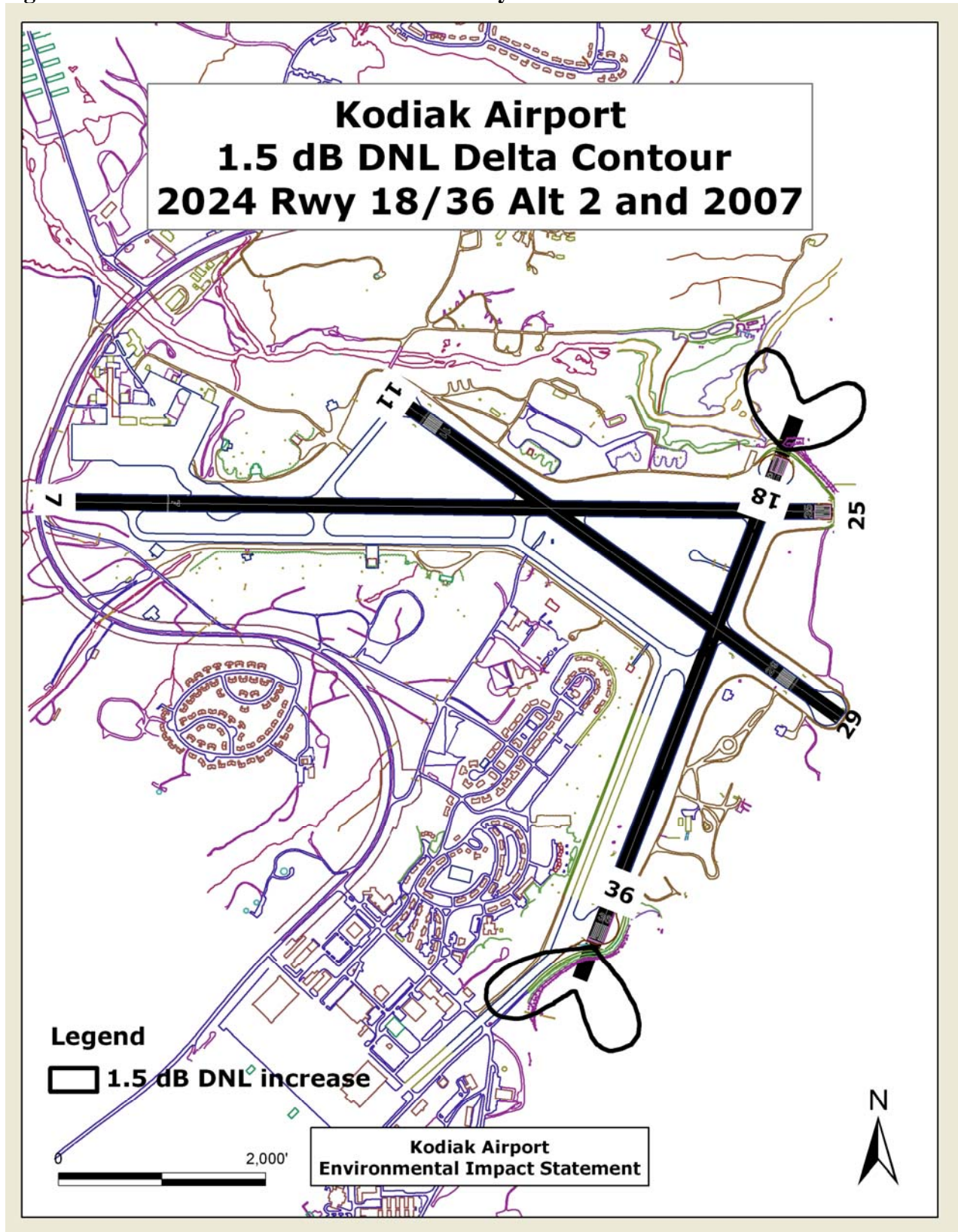
Source: Mestres Greve Associates (2009)

Figure 5-15 1.5 dB DNL Delta Contour 2014 Rwy 18/36 Alternative 4 and 2007



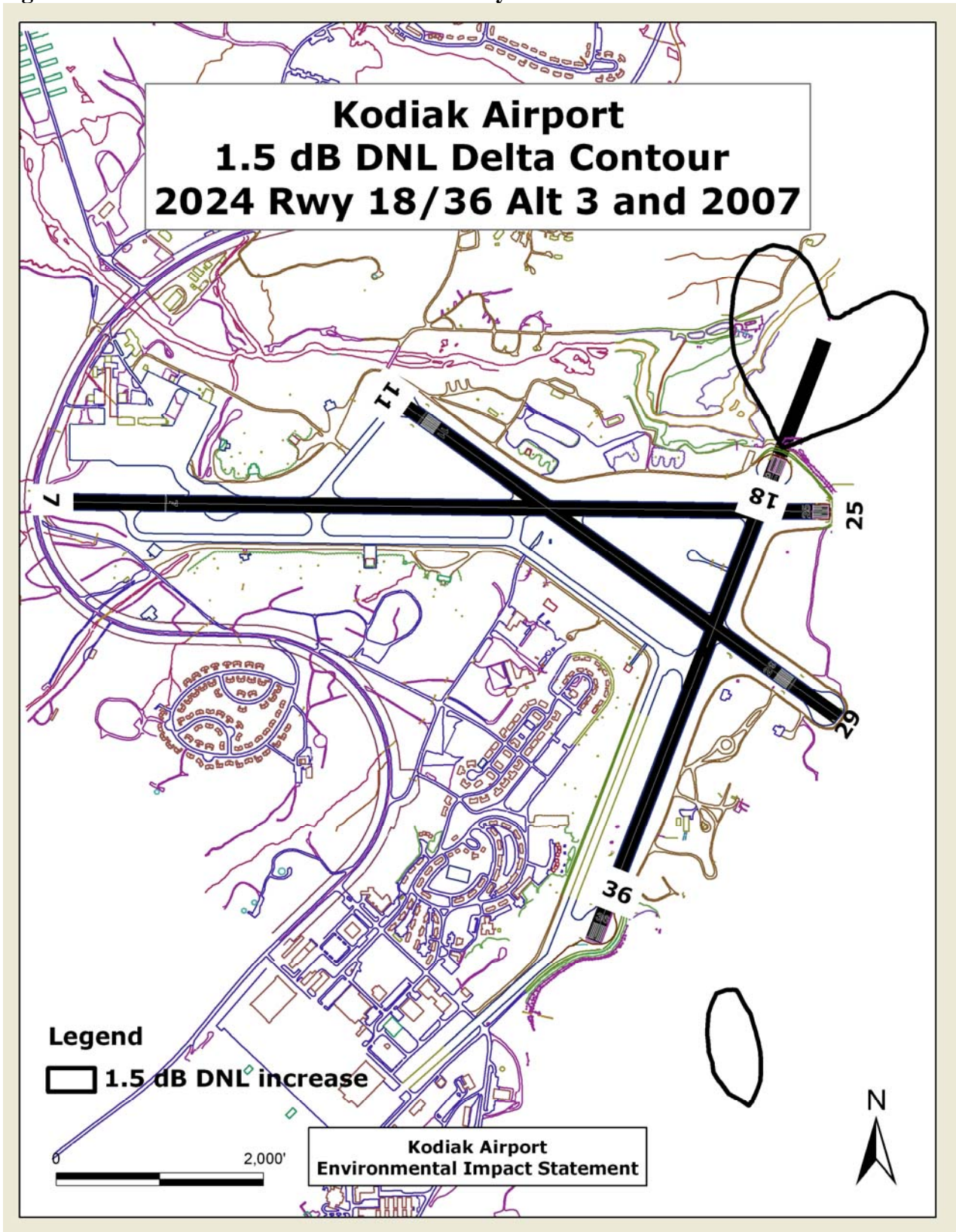
Source: Mestre Greve Associates (2009)

Figure 5-16 1.5 dB DNL Delta Contour 2024 Rwy 18/36 Alternative 2 and 2007



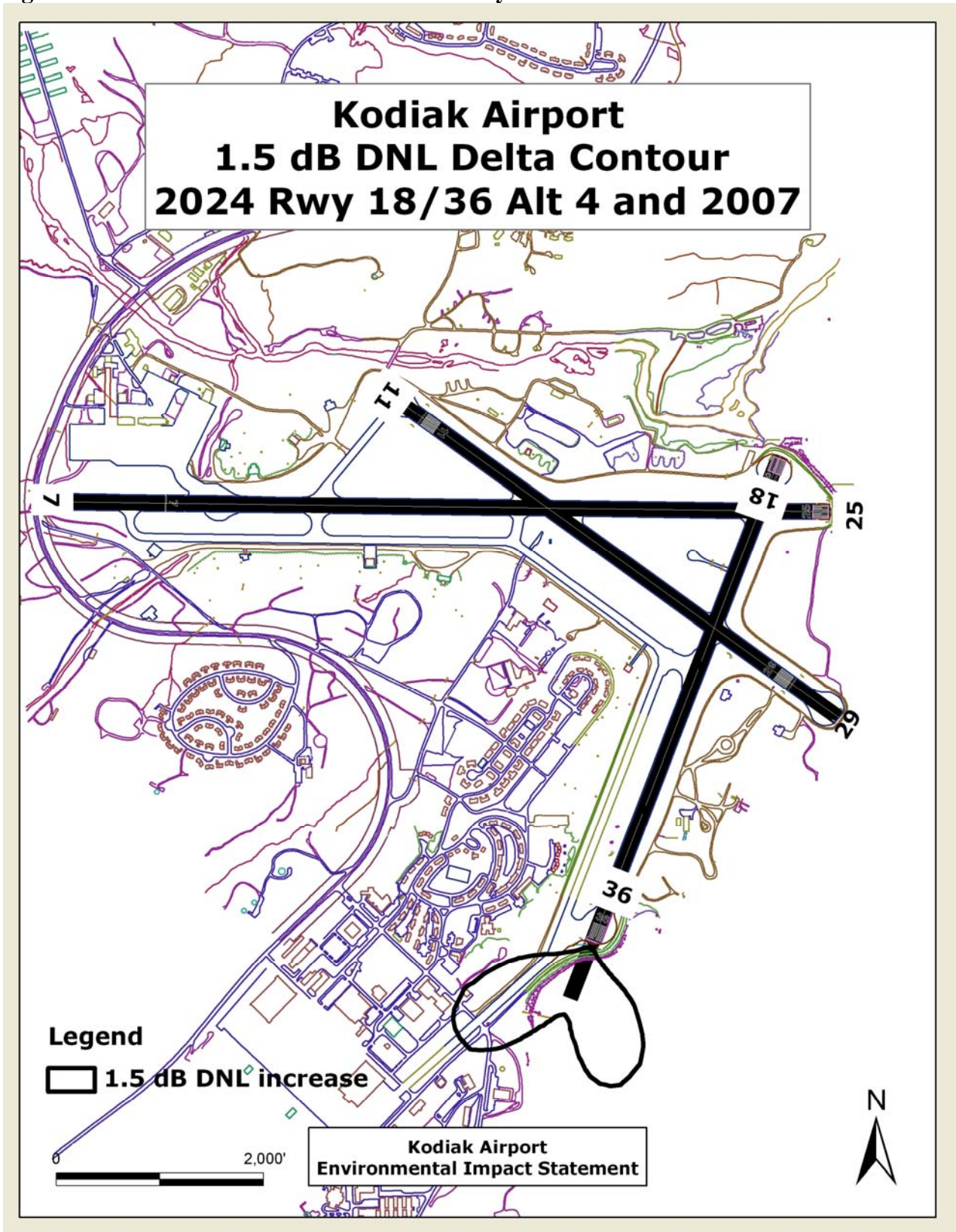
Source: Mestre Greve Associates (2009)

Figure 5-17 1.5 dB DNL Delta Contour 2024 Rwy 18/36 Alternative 3 and 2007



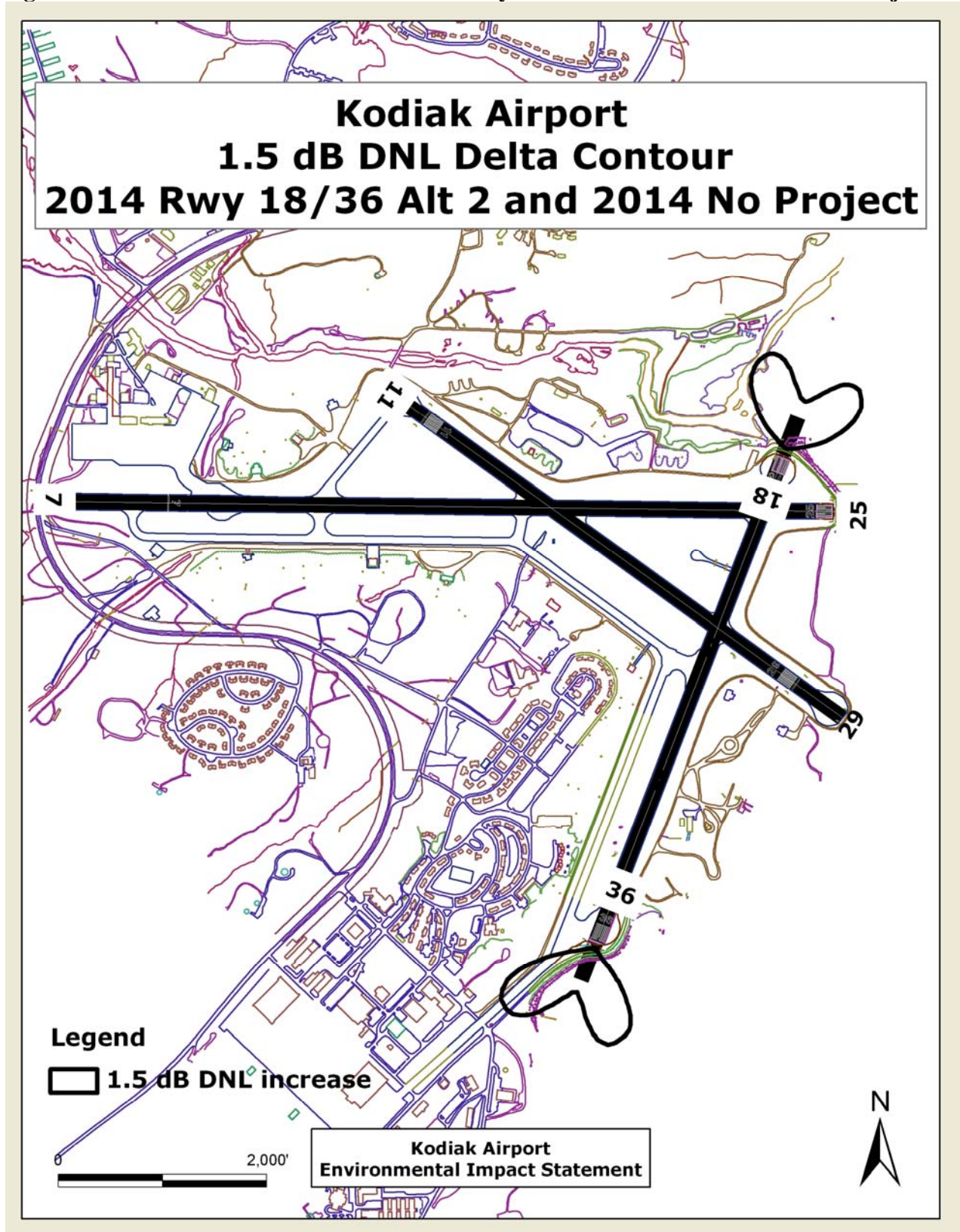
Source: Mestre Greve Associates (2009)

Figure 5-18 1.5 dB DNL Delta Contour 2024 Rwy 18/36 Alternative 4 and 2007



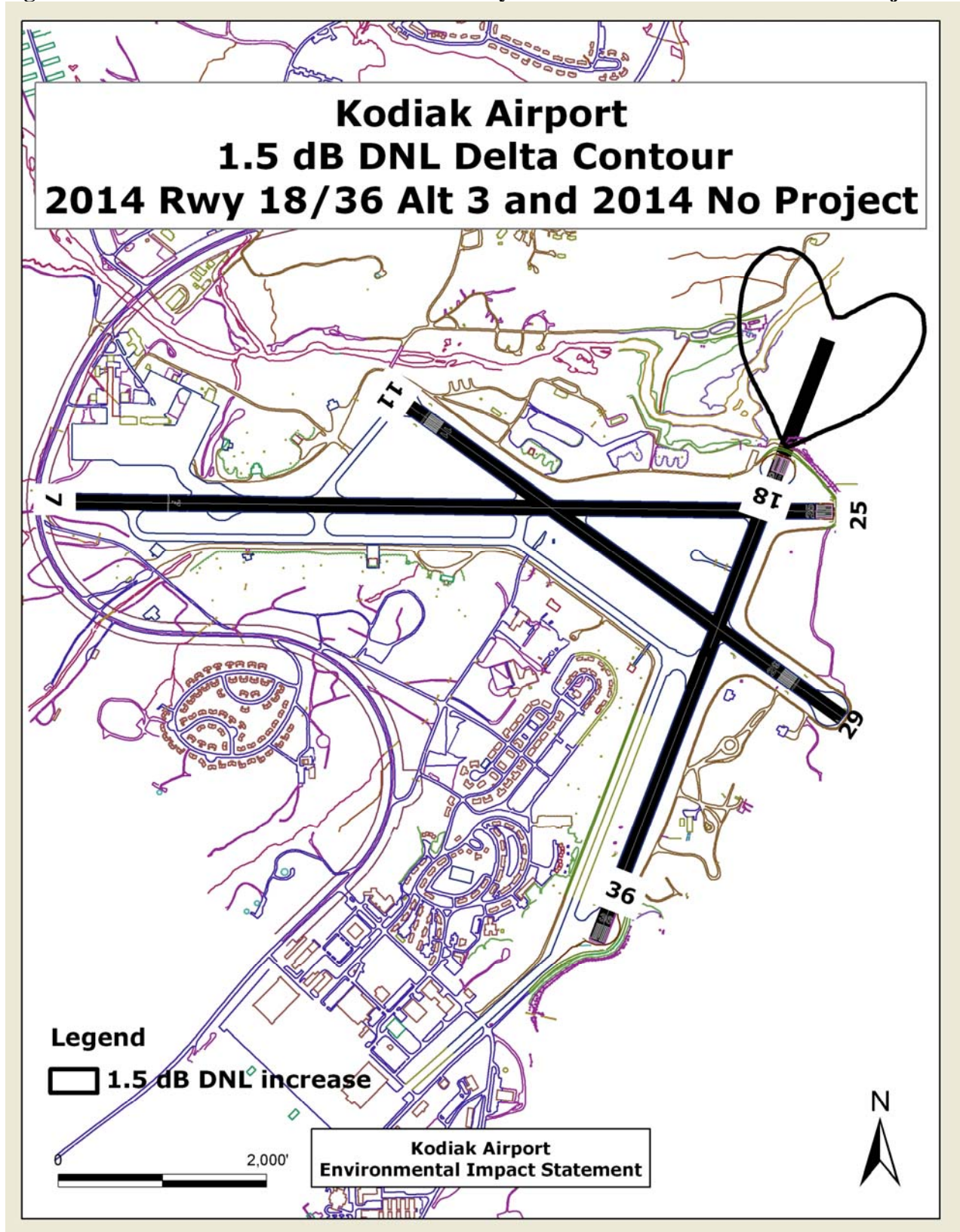
Source: Mestre Greve Associates (2009)

Figure 5-19 1.5 dB DNL Delta Contour 2014 Rwy 18/36 Alternative 2 and 2014 No Project



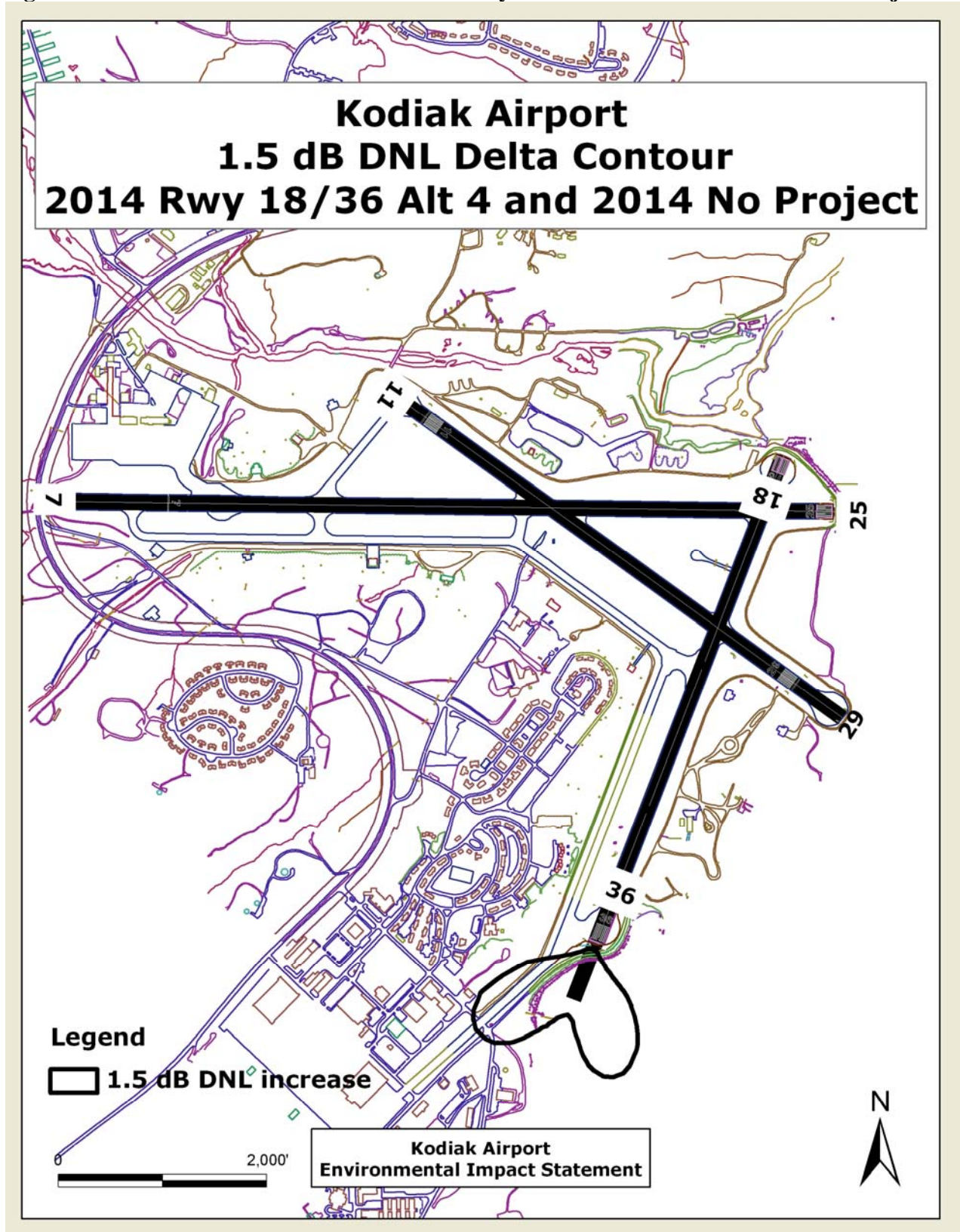
Source: Mestre Greve Associates (2009)

Figure 5-20 1.5 dB DNL Delta Contour 2014 Rwy 18/36 Alternative 3 and 2014 No Project



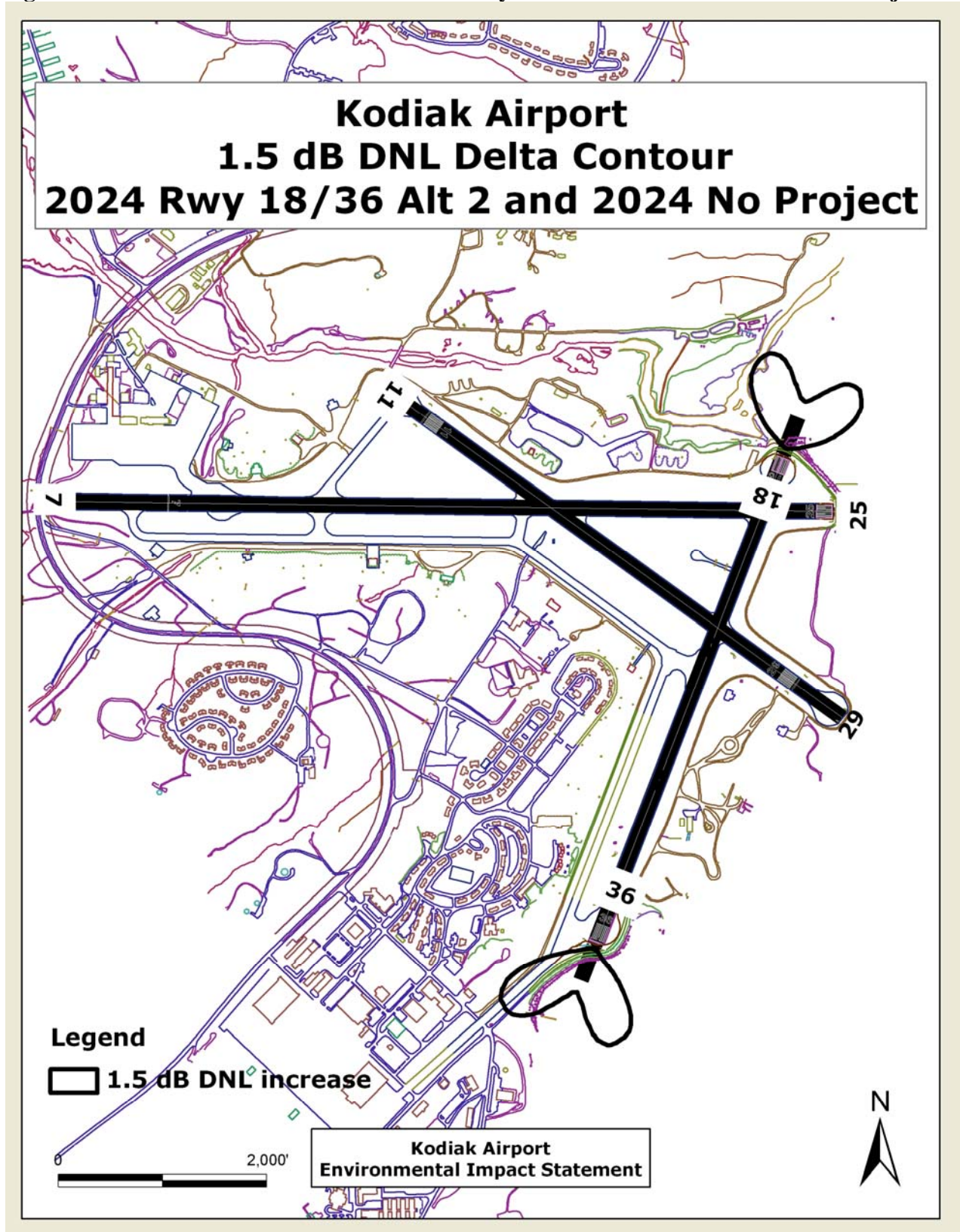
Source: Mestre Greve Associates (2009)

Figure 5-21 1.5 dB DNL Delta Contour 2014 Rwy 18/36 Alternative 4 and 2014 No Project



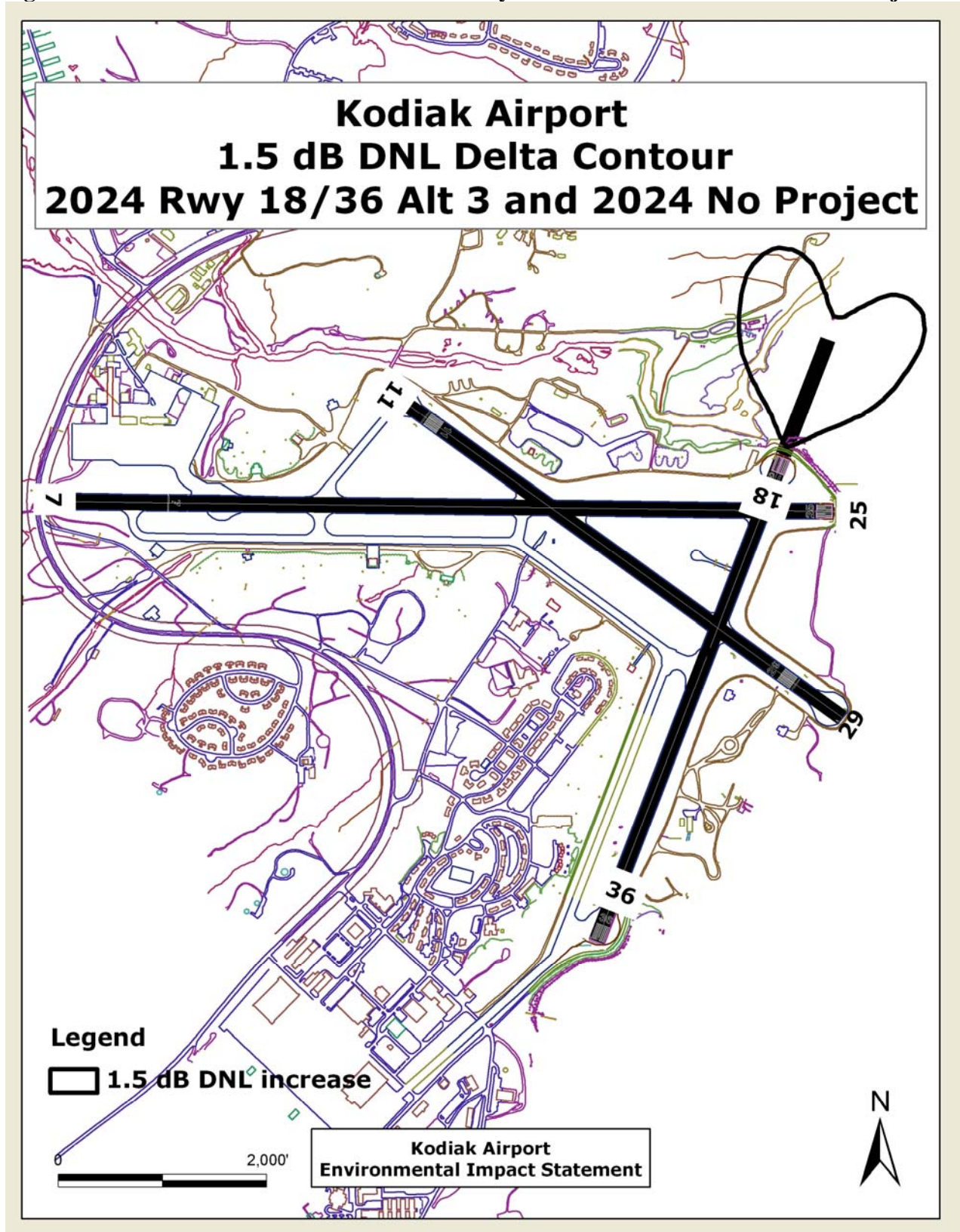
Source: Mestre Greve Associates (2009)

Figure 5-22 1.5 dB DNL Delta Contour 2024 Rwy 18/36 Alternative 2 and 2024 No Project



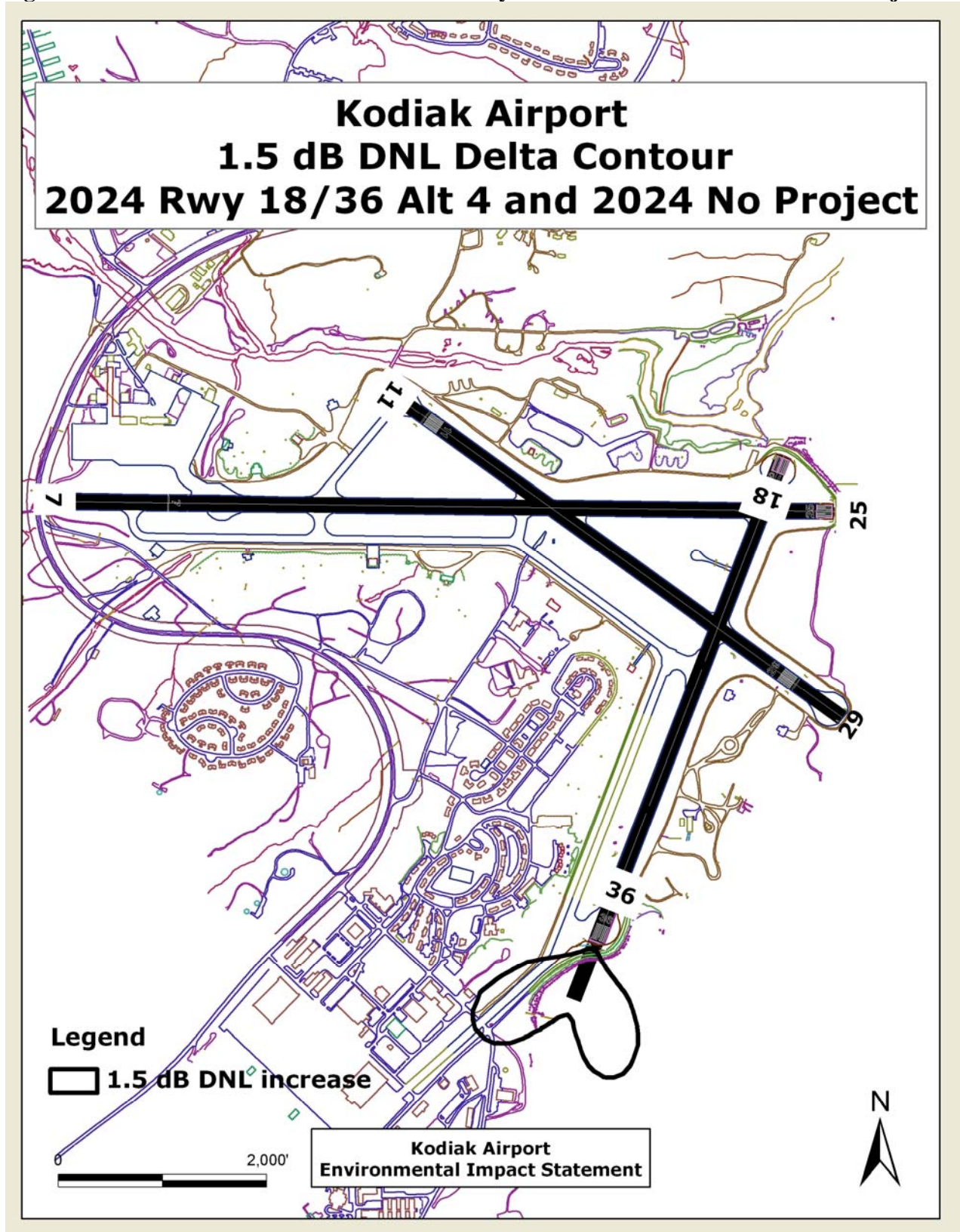
Source: Mestre Greve Associates (2009)

Figure 5-23 1.5 dB DNL Delta Contour 2024 Rwy 18/36 Alternative 3 and 2024 No Project



Source: Mestre Greve Associates (2009)

Figure 5-24 1.5 dB DNL Delta Contour 2024 Rwy 18/36 Alternative 4 and 2024 No Project



Source: Mestre Greve Associates (2009)

6.0 REFERENCES

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